CHAPTER

2. PROCESS APPROACH TO PROJECT MANAGEMENT

2.1 The project selected for this discussion is the Darwin Alice Springs Railway project.

(a) The major stakeholders are:

1. The citizens of Australia
2. The Northern Territory government
3. The South Australian governments
4. The government of Australia (the commonwealth government)
5. The Australasia railway corporation (established in 1997 by the Northern Territory and South Australian governments)
6. Contractors, subcontractors and suppliers
7. Workers on the project

(b) This was an external project performed for Australia (a joint venture between the northern Territory and the South Australian government) by the Australasian railway corporation.

(c) The most important resources used in the project were human resources, machines, measuring devices, and some raw materials.

1. Human resources. Because of the complex nature of the project, an exceptional need existed for licensed individuals and other experts. Although there was no lack of labor in the area, highly motivated and capable workers can make the difference between project success and failure.
2. Raw material needed for the project (e.g., 146,000 tons of steel rail, 2 million concrete sleepers, 2.8 million tons of ballast, 100,000 cubic meters of pre-stressed concrete and much more.)
3. Special machines. The machines played an important role because the sleepers and the steel rails were too heavy to be carried by men. The machines are the "common worker" here and workers only operate them.
4. Accurate measuring devices. If a line were one degree off from its planned bearings its terminal point would be 2.5 km inland with respect to the port of Darwin, the desired terminal point, or 2.5 km out at sea.

(d) The needs of the stakeholders:

1. The citizens of Australia
2. The Northern Territory government
3. The South Australian governments
4. The government of Australia (the commonwealth government)

The Northern Territory economy is small. It relies on world demand for mining, farming, and tourism (though domestic tourism is more important than international). But the Northern Territory also has a solid base of defense and government employment, with the defense presence notably built up in the past decade.
Due to its size and its exposure to export markets, the Northern Territory's economic performance is volatile, but, on average, the past decade has seen it outperform the wider Australian economy in both output and job growth. That strong performance was led by mining and related activities (including some offshore), the defense build up, and the fact the Northern Territory is at an earlier stage of development, and so benefits from extra capital works (such as the Darwin-Alice railway). Recent Northern Territory economic growth has been modest, with the Defense build up moderating and tourism stagnating. The resultant slower population growth has meant little housing construction for three years. Nevertheless, other projects are expected to pick up the commercial construction slack, the global economy is recovering, and so too is the outlook for tourism.

The railway is expected to reduce the transport costs for goods from the inlands to the rapidly growing markets of East Asia and bring tourism into the inland. It is the only rail connection between South Australia and the north. Given the fact that ground transportation is less expensive than air and given the rapidly growing markets in the north, for Australia this railway has to become a success story, at least from an economic point of view.

1. The Australasian railway corporation (established in 1997 by the Northern Territory and South Australian Governments) holds exclusive rights to operate the entire line for the next 50 years.
2. Contractors, subcontractors and suppliers. These are for profit firms for which the project is a source of income and expertise.
3. Workers on the project. The workers are looking for good jobs that pay well and will allow them to develop their skills.

(e) The alternatives for the project are:

1. The road system which is already built and functional;
2. Using the sea as a transportation platform (combined with the road system for inlanders);
3. Using the airways, again combined with roads.

   All three are cheaper in the short run – mainly because they already exist – but in the long run each has disadvantages that limit the volume and weight of goods that can be transported. Slower transportation rates ultimately mean higher costs. Another alternative is to design a high-speed railway system that would increase throughput but be far more expensive to build and maintain. In the view of the planners, however, the conventional railway system is expected to satisfactorily meet the needs of the region (mainly industrial needs).

(f) The northern territory government ordered a comparison between the road option and the rail option and obtained the following results.

- For trucks:
  i. The average truck operating cost within the corridor is estimated at 3.26 cents/ntk (net tonnes-kilometer).
  ii. The average truck operating cost for operations outside of the corridor is estimated at 3.70 cents/ntk.

- For rail:
  i. rail operating costs were estimated using the Booz·Allen rail cost model at 1.82 cents/ntk for the operations within the corridor.
  ii. 2.75 cents/ntk for operations outside of the corridor.

In both cases, the operating costs are projected to decline by 1.5% per annum for 30 years due to (1) improvements related to economies of scale and future productivity gains, (2) changes in the fleet mix leading to increased capacity and improvements in fuel efficiency, and (3) better technology leading to better maintenance of the road vehicles, which include the following truck types: articulated 6-Axle, B-double, double road train, and triple road train.

In addition, the following savings in externalities are expected:

- Savings in road infrastructure costs is 0.770 cents/ntk for trucks operating within the Adelaide to Alice Springs corridor and 0.901 cents/ntk for trucks operating outside the corridor. The estimates are based on the Travers Morgan report.
- Savings in road accidents are estimated to be 0.183 cents/ntk for trucks operating within the corridor and 0.319 cents/ntk for trucks operating outside the corridor. These values were derived from the latest ARRB Accident costs for articulated vehicles.
- Savings from the reduction in greenhouse gas emissions is based on work by VTES (1994) on CO2 vehicle emissions and Moffet (1991) cost estimates. The costs related to greenhouse gases for this analysis are 0.05 cents/ntk for rail and 0.10 cents/ntk for road.

Based on the analysis conducted during the study, the rationale for the selected alternative is as follows.

- The port connected to this rail is the closest one to the designated markets. This gives it an important role in Australian economy especially in the "global era" and in light of mining activities, which support the local economy.
- The existence of the line will play a key role in unlocking the development potential of the Northern Territory's largely untapped mineral reserves.
- The project makes Darwin a gate for tourism and the rail will make it easier to travel within Australia. Given the vast distances, rail is a better and more

comfortable way of travel than road or air for both people. It is also more economical for goods.
- For the inland cities that will gain a gate towards the sea, the project is definitely a big boost; for the rail company it is a "win-win" situation.
- In the short run this may seem to be an expensive project, but according to the analysis, it will pay for itself in a few years and remain a major asset for the state and citizens.

The results of a 50-year economic evaluation using a discount rate of 5% are summarized in the table below.

Results of Economic Evaluation	
Measure	Project case ($M)
Capital costs (present value)	926
Benefits (present value)	1,737
Net present value	811
NPV/capital costs	0.88
Internal rate of return (%)	9.2
Benefit / cost	1.88

With an initial capital cost of $926 million (PV), the project yields a net benefit of $811 million, giving a benefit-to-cost ratio of 1.88 and an internal rate of return of 9.2%.

The table below provides a breakdown of the various sources of project benefits.

Source of project benefits	Project case ($M)	%
Operating costs improvements	913	53
Accident costs avoided	181	10
Avoidance of intermodal transfer costs	15	1
Road infrastructure cost savings	574	33
Greenhouse gas savings	54	3
Total	1,737	100

The primary source of benefits is the savings in operational cost for tonnage diverted to the new rail link. The reduction in road infrastructure costs due to the diversion of freight from to rail is the next major benefit source.

Sensitivity Analysis: A number of sensitivity tests were conducted and the results shown in the following able.

Sensitivity measures	NPV ($M)	NPV/C	B/C	IRR
Baseline evaluation	811	0.88	1.88	9.2%
Project rail operating costs: +10%	713	0.77	1.77	8.8%
Project rail operating Costs: – 0%	910	0.98	1.98	9.7%
Rail task: +10%	908	0.98	1.98	9.7%
Rail task: –10%	598	0.65	1.65	8.3%
Rail task: –20%	432	0.47	1.47	7.5%
Project construction costs: +10%	718	0.71	1.71	8.5%
Project construction costs: –10%	903	1.08	2.08	10.1%
Road operating costs: 0% annual decline	1425	1.54	2.54	11.2%
Road operating costs: –3% annual decline	396	0.43	1.43	7.5%
7% discount rate	310	0.35	1.35	9.2%
3% discount rate	1714	1.78	2.78	9.2%

The results show that the NPV ranges from $310 million to $1,714 million with the benefit-to-cost ratio (B/C) ranging from 1.35 to 2.78. Moreover, the internal rate of return (IRR) ranges from 7.5% to 11.2%, indicating that under all scenarios investigated the NPV of the project is positive at the selected discount rate of 5%.

(g) The risks of this project are of two types:

- Risks that may hamper the completion of the project
- Risks that might make the project to “a white elephant”:

(h) The following list of risks is arranged by severity and phase.

- Pre-construction
  1. Inability to acquire the lands needed for the rail as planned.
  2. Lack of cash.
  3. Design and Over-investment – building an “overqualified” line for a faster train with the entire infrastructure involved.
  4. Subcontractor failure (bankruptcy).
  5. Insufficient raw material (mainly sleepers, steel rail and ballast)
  6. Opposition of the public due to environmental damage.

- Post-construction. While the Northwest Territory is projected to be a fast growing economy in comparison to the rest of Australia, its small size and resource strengths also point to it being a more volatile one. As a consequence, its past may not accurately reflect its future. Additional risks include:

7. High maintenance costs.
8. The $A rising beyond current expectations. This would have the effect of making some projects uncompetitive, putting at risk the strong investment outlook, and weakening the outlook for tourism and education exports.
9. Darwin's proximity to potentially unstable Asian trouble spots of terrorist activities. This has diverted tourists from the Asia-Pacific and may continue to do so.
10. The global recovery stuttering. While current signs are good, if global demand were to stagnate again the effect on the NT's resources and tourism sectors would be strongly negative.
11. "Acts of God" – cyclones (and other natural phenomena) may be a higher risk for Darwin than for other Australian capital cities.

(i) The following steps were taken to mitigate the risks.

- Land and environmental risks. While the Austral Asia Railway Corporation coordinated the tender process and negotiations, the Northern Territory government had primary responsibility for negotiating with aboriginal Land Councils and pastoralist regarding acquisition of the corridor (with compensation payments of $A 22 million). Environmental and heritage issues had to be addressed and fencing the corridor was required.

  A draft environmental impact statement was released in 1983 and updated with a new environmental management plan in 1997. At that time, the project received environmental approval from the Northern Territory and from the commonwealth governments.

  The Northern Territory obtained Sacred Sites avoidance certificates in accordance with the Northern Territory Aboriginal Sacred Sites Act for an area of extending 200 meters on either side of the railway centre line and for the identified ballast sites outside the corridor. Various reports were commissioned to determine the likely impact of the railway on sites of archaeological and historical significance.

  The Aboriginal Areas Protection Authority has pegged all Aboriginal sites of significance and good working relationship between the Authority, Adrail and Aboriginal organizations is ensuring close cooperation throughout the project.

  The area of the Gouldian Finch Wet Season Feeding Habitat affected by construction of the railway has been reestablished using plants from a nursery set up prior to the construction.

  Adrail, with assistance from Greening Australia and the Kybrook Farm community at Pine Creek, have completed the required rehabilitation on the site at Yinberrie Hills.

  The railway will have no impact on the heritage values of any declared heritage site; however, certificates have been obtained where the railway passes close to three declared heritage sites on the route of the old North Australian Railway line.

- Funding. The government's funding approach to the project was to provide an up front payment to ensure the railway is commercially viable and then let the private sector take over and bear the construction and the operating risks.

  The Austral Asia Railway Corporation was established in 1997 by the South Australian and the North Territory governments after several failed attempts to have railway fully funded by the commonwealth government or a private company. Once government support had been affirmed, the corporation took the project to the market. In 1999, the Asia Pacific Transport (APT) Consortium was selected as the preferred tenderer and negotiations began on contractual details. In October 1999, government funding was finalized, with the Northern Territory providing $A 165 million, the South Australian Government $A 150 million, and the commonwealth $A 165 million. In January 2001, another $A 79 million in stand-by funding was provided by the three governments on commercial terms.

  The model of BOOT (build, own, operate, transfer) was chosen and the ownership period set to 50 years – making it so affordable that 30 tenders were received from 60 national and international companies submitting expressions of interests.

- Design. High speed trains, particularly for passenger service, are very effective for moving large numbers of passengers in congested, densely populated areas, but require a wider corridor than conventional systems. In addition, electrification is generally feasible only in cities or heavily populated rural areas, while the need to connect older rail lines designed for slower trains cannot accommodate high speed lines without extensive upgrading.

  The design chosen allows freight trains to travel at a maximum of 115 kph, although they operate most economically at 90 kph. Each train will be able to handle 250 double stacked containers, will be 1600 meters long, and will be powered by 4000 hp locomotives. Initially, there will be one train in each direction only. Still an upgrade will be needed for the older part of the rail.

- Subcontractors. APT established two companies – Adrail and FreightLink Pty – to operate as the main subcontractors for the project. Organizationally, the project was divided between many subcontractors and suppliers mostly according to their expertise and location so if one supplier failed for any reason another could take his place. Difficulties may still arise from suppliers such as Whyalla who is the sole source of steel rails, but precautions were taken to minimize them. In the case of Whyalla, payment was made in advance allowing it to pay it's big suppliers in advance

  Some suppliers such as Austrak built special factories for this project (the sleeper factories in Katherine and Tennant Creek) and ballast quarries were also built in several locations near the rail's corridor. Above all, a tight but feasible schedule was set for each subproject.

- Raw material. To lower the transportation costs and to keep to schedule, special factories were built for the project in several nearby locations (Katherine's and

Tennant Creek's sleeper factories and ballast quarries). Moreover, additional ballast site were identified and built along side the rail's corridor. For transshipment purposes, a logistics centre was built in Roe Creek – about 20 km south of Alice Springs, where the materials sent from south were concentrated and shipped north.

- High maintenance costs. To reduce the maintenance costs, the rail was constructed using a continuous weld line process so there are no joints to maintain. The strength and the quality of the welds are sufficient to hold the tracks together and prevent expansion or shrinkage of the steel. The cement sleepers are stronger and long lasting in comparison to those constructed from wood. The rails are held to the sleepers by heavy-duty spring clips, which prevent the rail from moving along the track. The weight of the sleepers and the friction of the ballast prevent any movement.

- Global recovery. Cost and revenue calculations were done using today’s economic data and market forecasts. The company expects the rail to create new opportunities and thus enlarge its transportation capacity.

  Since the start of the 2001 global recession, the eastern markets (which are the main clients of the Darwin Port) have been growing rapidly. They have one of the lowest paid workforces in the world so as recovery takes hold, these markets will improve along with the economic outlook for the project.

(j) Based on the September 25th 2003 report, the track laying component of the project was completed much sooner than planned without any cost overruns. The entire infrastructure was built on schedule and the rail is ready to be used earlier than expected. At the end of June 2003, the company met its last financial commitment.

Looking at the benefits gained so far, the project has all the earmarks of a success:

- 1500 direct jobs and training opportunities were created (at peak) during construction and many more as a result of flow-on efforts to service and supply outlying areas
- Over $A 1 billion worth of contracts have been let to Northern Territory and South Australian companies
- Strong relationships have been built with local indigenous people, and major environmental and preservation activities have been carried out
- A new trade route (to Asia) has been built between the 500 million people to the north and the economic heartlands of south-eastern Australia
- Cheaper freight and competitive freight options now exist for the growing industrial base in the Northern Territory, and another option exists for cattle movements
- There has been a major boost to regional development and improved support for both the growing agribusiness in the Northern Territory and for South Australian food and wine exports.

- Cheaper transportation options have lent greater support to mineral exploration along the rail corridor.
- The new rail line has enhanced defense readiness by providing increased transportation options for troops and equipment.

(k) Of the $A 1.3 billion spent on the project, over 1.079 billion was awarded to industries in the Northern Territory and South Australia according to the contract documents. APT was required to allocate at least 75% of its budget to firms based in these regions. This was agreeable because its primary expertise is in railway operations. As a result, virtually all of the infrastructure associated with the project, such as buildings, fueling stations, carts, the port, quarries, and sleepers, was outsourced. This led to significant cost savings.

(l) Lessons learned

- Good planning is essential – a well-crafted plan pays off tenfold, providing solutions to problems before they arise
- Outsourcing may allow for better use of existing resources and lead to improved quality
- A well-designed project management process and good information flow are the keys to success

2.2 The solution is based on the information in the following article.

E. A. Stohr and J. L. Zhao, "Workflow Automation: Overview and Research Issues," *Information Systems Frontiers*, Vol 3, No 3, pp 281-296 (2001).

(a) Advantages of workflow systems. In general, workflow systems can help businesses reduce costs and streamline operations. By using the correct process modeling technique and by defining detailed routing and processing requirements for the workflow, automation of the work process is enabled. As a result, human mistakes are minimized, work hours are saved, and operations flow smoothly.

- Workforce systems provides the following benefits:
  - i. Simulation, prototyping and piloting – some systems have these options to allow testing before production begins
  - ii. Improved efficiency – mostly through automation of business processes and work lists
  - iii. Improved customer service – through consistency in the processes
  - iv. Improved/increased information flow – each step of the workflow identifies the required documentation and documentation routing, and provides limited access for remote customers, suppliers, collaborators, or staff to this information
  - v. Improved process control – helps management to better understand processes and improve the quality of outcomes
  - vi. Flexibility – software control over processes enables the redesign of workflow as business needs change, thus creating opportunities for organizational change
  - vii. Business process improvement – through focus on business processes

(b) To be able to use a workflow management system in a project the following conditions must be present.

- The entire project has to be fully understood and mapped into processes.
- All processes involving human decision making have to be defined.
- The information on which the decision rules are built must be accurate and reliable.
- The project scope has to be divided into processes and each of these has to be well defined; i.e.,
  - i. Each action and resource involved must be identified and the information flows defined
  - ii. Decision making rules have to be built including 'go'/ 'no go' for each step; exceptions should be noted
  - iii. The start and end of each process must be clearly specified.

(c) Of the nine process knowledge areas defined in the PMBOK, the oned best suited for workflow systems are in the procurement area. Purchasing functions tend to be project independent so the same process can be used repeatedly for different projects.

(d) The main problem in using a workflow system in a project is its dynamic, stochastic, one-time nature. Automated systems are designed to work in a static environment with permanent well-structured processes where the input data rarely change. In a dynamic, stochastic environment, the rigidity introduced by a workflow system may hurt the flexibility needed in the project environment while at the same time reducing the effectiveness of the workflow system. The problem is exacerbated by the fact that projects are, by definition, different from each.

2.3

(a) The "learning organization" is the label being used for an integration of a set of ideas that have emerged from organizational research and practice over the past three or four decades on ways of arranging work to met the often-conflicting demands of organizational objectives and individual job satisfaction. The learning organization is, in many ways, a natural evolution of older participatory management themes of the 1970s with recent emphasis on empowerment and self-managed work teams. It is not so much characterized by its altered structure (flatter and less hierarchal) and team emphasis, but by the transformation of the relationship of the organization to the individual and increased capacity for adaptation and change.

The previous overriding concern for control (e.g., motivate others, organize work for others, set goals for others) is replaced by a concern for learning by all organizational members on behalf of the organization. Learning about technical things and their relationship to the external environment is greatly valued, as is learning about organizational processes. A learning organization expects its members to " . . . act as agents, responding to changes in the internal and external environment of the organization by detecting and correcting errors in organizational theory-in-use, and embedding the results of their inquiry in private images and shared maps of organization." [C. Argyris and D. Schön, *Organizational learning II: Theory, Method and Practice*, Addison Wesley, Reading, MA (1996)].

(b) Peter Senge's 1990 book,

The Fifth Discipline. The Art and Practice of the Learning Organization
Random House, London

describes the five elements that make a learning organization:

1. Personal mastery: Learning to expand our personal capacity to create results we most desire, and creating an organizational environment which encourages all its members to develop themselves toward goals and purposes they choose.
2. Mental models: Reflecting upon, continually clarifying, and improving our internal pictures of the world, and seeing how they shape our actions and decisions.
3. Shared vision: Building a sense of commitment in a group by developing shared images of the future we seek to create as well as the principles and guiding practices by which we hope to get there.
4. Team learning: Transforming conversational and collective thinking skills so that groups of people can reliably develop intelligence and ability greater than the sum of individual members' talents.
5. Systems thinking: A way of thinking about and a language for describing and understanding forces and interrelationships that shape the behavior of systems. This discipline helps us see how to change systems more effectively and to act more in tune with the larger processes of the natural and economic world.

(c) The learning organization has the following advantages:

- It creates superior performance and quality – Because the organization is constantly learning and improving, its processes and products are also being constantly improved.
- It creates a competitive advantage – By improved processes and by achieving expertise the organization in able to make better products using more effective and cheaper processes (in comparison to past products and to the competition).
- It creates an energized, committed workforce – The workers are committed to the goals of the organization since they are involved in setting and achieving them. They are full participants in the learning process, and their success in becoming experts in their fields will encourage the organization to use their skills and promote them.
- It creates organizational changes – A learning organization better adjusts to change and is able to make them faster and more effectively when the environment dictates.

(d) To promote a learning organization in the project environment an organization has to identify and encourage professionalism on the part of its project managers. All workers should be rewarded for performance and encouraged to think and initiate process improvement. Progress must be documented but also mistakes. Information should be maintained within the organization for future use when best practices are identified (organizational memory). Performance has to be measured and documented as well.

An information system should be established enabling workers to enter the existing documentation and knowledge base of the organization and to communicate with fellow workers in order to exchange thoughts and information.

Figure 2.1 Spiral life-cycle model.

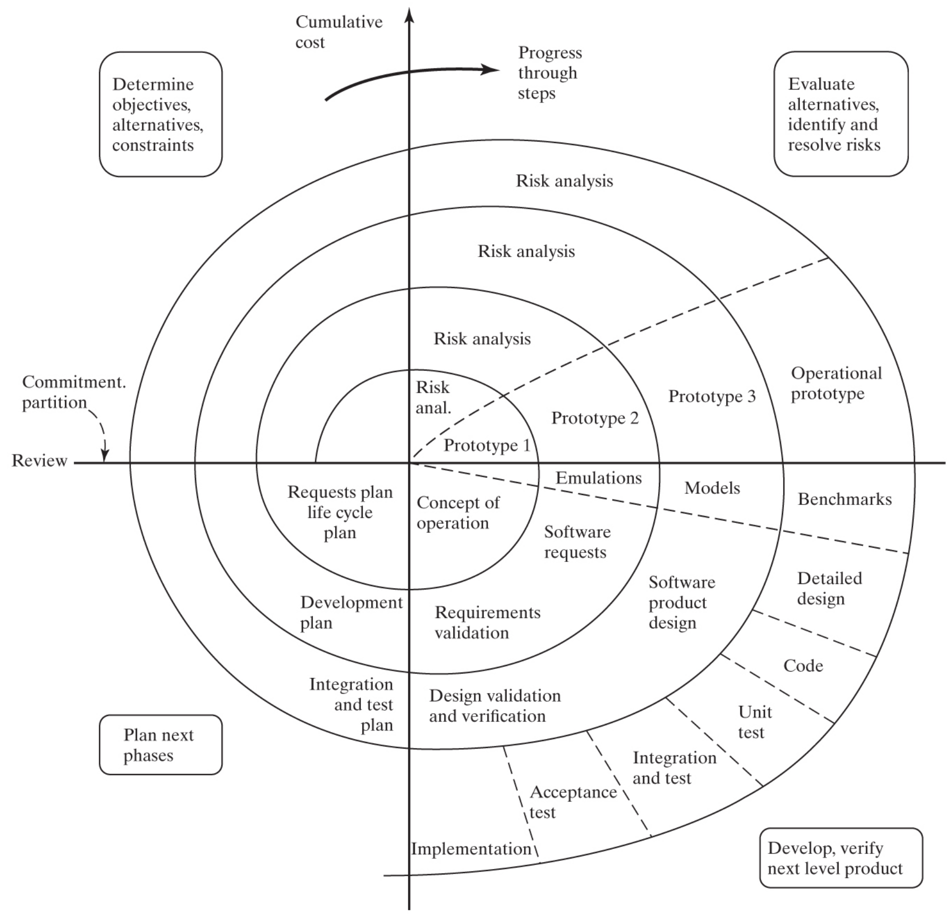

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Figure 2.2 DOD life-cycle model.

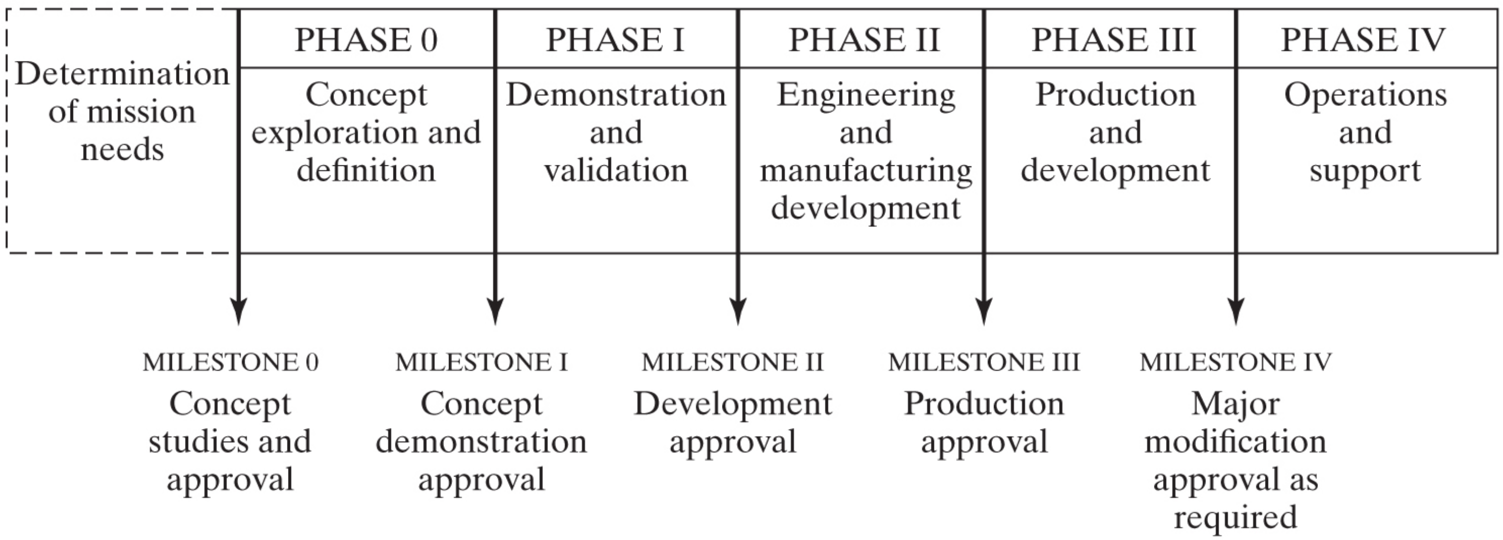

Figure 2.3 Waterfall model.