<table>
<thead>
<tr>
<th>SNo</th>
<th>TOPICS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>What is Project?</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Characteristics of a Project</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Project Management – Definitions</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Parameters for Success of a Project</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Externalities</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td><strong>Industrial Policy</strong></td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Main Features of the Current Industrial Policy</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Incentives offered by state governments</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>Specific Government Approval for Entering into a Foreign Technology Agreement</td>
<td>11</td>
</tr>
<tr>
<td>11</td>
<td>Impact of Liberalisation on Industrial Development</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>Sales Tax Exemption Vs Deferred Sales Tax Schemes</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>SSI Sector Eligibility Criteria, Provisions and Incentives</td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>Business Evaluation Tools</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>B C G Matrix</td>
<td>14</td>
</tr>
<tr>
<td>16</td>
<td>General Electric’s Stoplight Matrix</td>
<td>15</td>
</tr>
<tr>
<td>17</td>
<td>McKinsey Matrix</td>
<td>15</td>
</tr>
<tr>
<td>18</td>
<td>Porter Generic Strategies</td>
<td>16</td>
</tr>
<tr>
<td>19</td>
<td>Tools For Identifying Investment Avenues</td>
<td>19</td>
</tr>
<tr>
<td>20</td>
<td>Porter’s Five Forces Model</td>
<td>19</td>
</tr>
<tr>
<td>21</td>
<td>Criticism</td>
<td>24</td>
</tr>
<tr>
<td>22</td>
<td>New Product Idea Generation Techniques</td>
<td>25</td>
</tr>
<tr>
<td>23</td>
<td>Why Companies Scout for New Project Ideas</td>
<td>25</td>
</tr>
<tr>
<td>24</td>
<td>Steps While Choosing a New Project Idea</td>
<td>25</td>
</tr>
<tr>
<td>25</td>
<td>Methods of Idea Generation</td>
<td>26</td>
</tr>
<tr>
<td>26</td>
<td>Project Appraisal</td>
<td>28</td>
</tr>
<tr>
<td>27</td>
<td>Facets of Project Analysis</td>
<td>28</td>
</tr>
<tr>
<td>28</td>
<td>Financial Appraisal</td>
<td>30</td>
</tr>
<tr>
<td>29</td>
<td>Scope of Financial Appraisal</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>Methods and Techniques of Financial Appraisal</td>
<td>30</td>
</tr>
<tr>
<td>31</td>
<td>Pay Back Period</td>
<td>30</td>
</tr>
<tr>
<td>32</td>
<td>Accounting Rate of Return</td>
<td>31</td>
</tr>
<tr>
<td>33</td>
<td>Discounted Cash Flow (DCF) or NPV Method</td>
<td>31</td>
</tr>
<tr>
<td>34</td>
<td>Benefit – Cost Analysis</td>
<td>32</td>
</tr>
<tr>
<td>35</td>
<td>Discounted Payback Period Method</td>
<td>33</td>
</tr>
<tr>
<td>36</td>
<td>Internal Rate of Return (IRR)</td>
<td>33</td>
</tr>
<tr>
<td>37</td>
<td>Relative Merits &amp; Demerits of N.P.V. &amp; I.R.R. Criteria</td>
<td>34</td>
</tr>
<tr>
<td>38</td>
<td>Marketing Appraisal</td>
<td>36</td>
</tr>
<tr>
<td>39</td>
<td>Main aspects of ‘Market Analysis’</td>
<td>36</td>
</tr>
<tr>
<td>Page</td>
<td>Topic</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Main uses of Market Analysis for Financial Analysis</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Situations When Time Series Analysis Methods Cannot be Used For Demand Forecasting</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Other Forecasting Methods</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Technical Analysis</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Main Aspects to be Considered in Technical Analysis</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Network Diagrams</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>PERT</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>CPM</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Drawing the Network Diagram</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>AOA Method/Arrow Diagramming Method -Some Ground Rules</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Significance of ‘Total’, ‘Free’ and ‘Negative’ Floats</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Critical Path’</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Crashing</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>‘Optimum’ Duration of the Project</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Necessity of Crashing</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>Numerical Problem on Crashing</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>Activity on Node (AON)/</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Advantages of ”Precedence Diagramming</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Legend</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>OtherTypes of Relationship</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Use of CPM in Optimisation of Project Cost.</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>Project Scheduling</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>Three Time Estimate method for Network Scheduling</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>‘Total Float’ and ‘Free Float’ Differ in Their Significance</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Resource Levelling / Smoothening</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Importance of Activity Duration Estimation</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Bar Chart</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Risk Management</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Risk Management Process</td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>Risk Analysis</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Use of Risk Analysis for Project Evaluation and Appraisal</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Types of Project Risks</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>‘Risk Analysis’ Considered as an Integral Part of Project Evaluation</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Incorporating Risk Factor in Project Evaluation</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Risk Register</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Decision Tree</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Application of Decision Tree Analysis</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Basic Steps Involved in the Analysis</td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Title</td>
<td>Reference</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>82</td>
<td>Example</td>
<td>71</td>
</tr>
<tr>
<td>83</td>
<td>Example</td>
<td>71</td>
</tr>
<tr>
<td>84</td>
<td>Scheduling With Resources</td>
<td>74</td>
</tr>
<tr>
<td>85</td>
<td>Process</td>
<td>74</td>
</tr>
<tr>
<td>86</td>
<td>Example</td>
<td>74</td>
</tr>
<tr>
<td>87</td>
<td>Logic</td>
<td>75</td>
</tr>
<tr>
<td>88</td>
<td>Comparative Advantages and Utilities of Gantt Charts</td>
<td>76</td>
</tr>
<tr>
<td>89</td>
<td>Example</td>
<td>76</td>
</tr>
<tr>
<td>90</td>
<td>Project Finance</td>
<td>78</td>
</tr>
<tr>
<td>91</td>
<td>Principles of Project Cash Flows</td>
<td>79</td>
</tr>
<tr>
<td>92</td>
<td>Example</td>
<td>80</td>
</tr>
<tr>
<td>93</td>
<td>Venture Capital</td>
<td>82</td>
</tr>
<tr>
<td>94</td>
<td>‘Project Investment’ Decisions VS Routine Manufacturing Investment Decisions</td>
<td>83</td>
</tr>
<tr>
<td>95</td>
<td>Break-Even Analysis</td>
<td>83</td>
</tr>
<tr>
<td>96</td>
<td>Example</td>
<td>84</td>
</tr>
<tr>
<td>97</td>
<td>Treatment of Project Cash Flow Items</td>
<td>84</td>
</tr>
<tr>
<td>98</td>
<td>Project Cash Flows</td>
<td>84</td>
</tr>
<tr>
<td>99</td>
<td>Elements of Cash Flow</td>
<td>85</td>
</tr>
<tr>
<td>100</td>
<td>Project Life Determination</td>
<td>85</td>
</tr>
<tr>
<td>101</td>
<td>Margin Money as Initial Investment</td>
<td>85</td>
</tr>
<tr>
<td>102</td>
<td>‘Weighted Average Cost of Capital (WACC) as a ‘Hurdle Rate’</td>
<td>86</td>
</tr>
<tr>
<td>103</td>
<td>limitations in Using WACC</td>
<td>86</td>
</tr>
<tr>
<td>104</td>
<td>Relative Merits of Building a Project Budget From ‘Bottom-up’</td>
<td>86</td>
</tr>
<tr>
<td>105</td>
<td>Methods for Comparing and Ranking Projects with Different Life- Spans</td>
<td>86</td>
</tr>
<tr>
<td>106</td>
<td>Project Management</td>
<td>88</td>
</tr>
<tr>
<td>107</td>
<td>EPC Companies Vs Own Diversification / Expansion Project Organisation</td>
<td>88</td>
</tr>
<tr>
<td>108</td>
<td>Validity of Trend Analysis in Demand Forecasting for Project Feasibility</td>
<td>89</td>
</tr>
<tr>
<td>109</td>
<td>Earned Value Method</td>
<td>89</td>
</tr>
<tr>
<td>110</td>
<td>Basic Functions of a Project Manager</td>
<td>91</td>
</tr>
<tr>
<td>111</td>
<td>Qualities, Qualifications &amp; experience</td>
<td>92</td>
</tr>
<tr>
<td>112</td>
<td>Human Aspects of Project Management</td>
<td>92</td>
</tr>
<tr>
<td>113</td>
<td>WBS (Work Breakdown Structure)</td>
<td>94</td>
</tr>
<tr>
<td>114</td>
<td>Project Monitoring &amp; Control Cycle</td>
<td>96</td>
</tr>
<tr>
<td>115</td>
<td>‘Project Monitoring’ Vs ‘Project Control’</td>
<td>96</td>
</tr>
<tr>
<td>116</td>
<td>Need to Break Project Budgets on the Basis of Project Activities</td>
<td>97</td>
</tr>
<tr>
<td>117</td>
<td>Importance of Entrepreneurial Abilities in Project Managers</td>
<td>97</td>
</tr>
<tr>
<td>118</td>
<td>Causes of Project Failures</td>
<td>98</td>
</tr>
<tr>
<td>Page</td>
<td>Topic</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>Application of Specialised Project Management Techniques to Non-Engineering Areas</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>Effect of Contract Management</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>Handling Project Scope Modification</td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Project Organisation</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>Unsuitability of Functional Organisation for Projects</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Other Types of Organisations</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>Organization Structure of a ‘Pure Project’ Organization</td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Stakeholders in a Project</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>Main Features and Advantages of ‘Matrix’ Type Organisation for Projects</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>Selection and Use of Software Packages for Project Management</td>
<td></td>
</tr>
<tr>
<td>129</td>
<td>Basic Features of the Project Management Software</td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCTION

What is Project?

A project is a non-repetitive (one-time) activity or set of activities spanning over a reasonable length of time and aimed at achieving a well-defined objective, scope, time, and resources. A project has a definite start and finish.

Projects are unique, transient endeavours undertaken to achieve a desired outcome. Projects bring about change and project management is recognised as the most efficient way of managing such change.

Characteristics of a Project–

- Project has a definite start and finish.
- Project consists of a well-defined collection of jobs, activities, or tasks which when complete, mark the end of the project.
- Most jobs are related backward (predecessors) and forward (successors).
- The jobs are ordered – i.e., they must be performed in technological order.

Project Management – Definition

Project Management is the process of defining, planning, monitoring, controlling, and delivering the project so that objectives of the project are realised within the constraints of time and resources.

"Project management is the process by which projects are defined, planned, monitored, controlled, and delivered such that the agreed benefits are realised."

Project management is the discipline of organising and managing resources in such a way that these resources deliver all the work required to complete a project within defined scope, time, and cost constraints. This property of being a temporary and a one-time undertaking contrasts with the processes or operations which are permanent or semi-permanent ongoing functional work to create the same product or service over and over. The management of these two systems is often very different and requires varying technical skills and philosophy and hence requiring the development of project management.

The foremost challenge of project management is to ensure that a project is delivered within the defined constraints of time, cost, and quality. From this overall challenge emanate the subsidiary challenges like, optimised application of resources.
Parameters for Success of a Project

A project is akin to a three legged stool. If any of these legs is not up to the mark, project is not fully successful. The three legs of project are -

1. **Scope** – Deliverables as per the contract. Performance as agreed upon in the contract.
2. **Time** – As agreed in the contract
3. **Cost** – As agreed in the contract

Degree of success of project is measured by the sum of performance on the three counts. Each project has its peculiarity. While Scope is most important in most cases, there are cases where time assumes paramount importance. A mega event, say Olympics, has no scope for time over run. There can be minor compromises on scope and cost but not on time. But in commercial contracts, cost and scope both have equal importance.

Defining the scope is very important. Scope should be defined in quantitative manner to the extent possible. Qualitative terms in scope definition only lead to litigation. Time and cost are functions of scope. “Big House” is as vague as it can get. Let the client specify how many rooms of what sizes he wants. Time and cost will be quoted accordingly. Any change in scope at a later date will result in either extra time or cost or both. If the scope is changed without changing time and cost then quality may be impacted. Quality problem may be noticed immediately or come to light in future.

Quality is hard to define, and even more difficult to specify. A broad understanding is required with the client regarding his quality requirements.

**Externalities**

Effects of an economic activity not included in the project statement from the point of view of the main project participants, and therefore not included in the financial costs and revenues that accrue to them. Externalities represent part of the difference between private costs and benefits, and social costs and benefits. Externalities should be quantified and valued, and included in the project statement for economic analysis.
INDUSTRIAL POLICY

Main features of the current Industrial Policy under the government’s liberalisation & economic reforms programme–

Objectives of the Industrial Policy of the Government are –

• to maintain a sustained growth in productivity;
• to enhance gainful employment;
• to achieve optimal utilisation of human resources;
• to attain international competitiveness and
• to transform India into a major partner and player in the global arena.

Policy focus is on –

• Deregulating Indian industry;
• Allowing the industry freedom and flexibility in responding to market forces and
• Providing a policy regime that facilitates and fosters growth of Indian industry.

Policy Measures

Some of the important policy measures announced and procedural simplifications undertaken to pursue the above objectives are as under–

• Liberalisation of Industrial Licensing Policy
• Introduction of Industrial Entrepreneurs’ Memorandum (IEM)
• Liberalisation of the Locational Policy
• Policy for Small Scale Industries
• Non-Resident Indians Scheme
• Electronic Hardware Technology Park (EHTP)/Software Technology Park (STP) scheme
• Policy for Foreign Direct Investment (FDI)

1. Liberalised Industrial Licensing – Industries are exempt from obtaining Industrial License to manufacture except –

   (a) Industries Reserved for Public Sector – Only three industries are reserved for public sector.
(i) Defence equipment, Defence aircrafts & warships, Arms & ammunition,
(ii) Atomic energy, Atomic minerals &
(iii) Railways.

(b) **Industries under Compulsory Licensing** – Only six industries on account of environmental, safety and strategic considerations Alcoholic drinks, tobacco processing & products, Electronic aerospace & defence equipment, Explosives & hazardous chemicals, Drugs & Pharmaceuticals.

(i) Distillation and brewing of alcoholic drinks.
(ii) Cigars and cigarettes of tobacco and manufactured tobacco substitutes.
(iii) Electronic Aerospace and defence equipment – all types.
(iv) Industrial explosives including detonating fuses, safety fuses, gunpowder, nitrocellulose and matches.
(v) Hazardous chemicals.
(vi) Drugs and Pharmaceuticals (according to modified Drug Policy issued in September, 1994).

*Note* – The compulsory licensing provisions would not apply in respect of the small scale units taking up the manufacture of any of the above items reserved for exclusive manufacture in small scale sector.

(c) Items Reserved for SSI Sector (List covers 749 items)

(d) If proposal attracts locational restrictions

2. **Introduction of Industrial Entrepreneurs’ Memorandum (IEM)** – Industries exempt from Industrial Licensing are required to file Industrial Entrepreneurs Memorandum (IEM) with the Secretariat of Industrial Approvals (SIA). No industrial approval is required for such industries.

3. **Liberalisation of the Locational Policy**

(a) No industrial approval is required for industrial location beyond 25 KM from the Standard Urban Area (SUA) limits in case of cities with population of more than 1.0 million.

(b) Above restriction does not apply to –

(i) Locations notified as Industrial Areas by the government.
(ii) SSI Sector
(iii) Electronics, computer software & printing industries
(iv) Industries obtaining Industrial License for specified location.

(c) Location will also be governed by local zoning, land use and environmental regulations of the state & central governments.

4. **Policy for Small Scale Industries**

(a) Investment upto Rs One Crore qualifies unit to be registered as a Small Scale Industry (SSI).

(b) Investment limit upto Rs 5 Cr for 41 especially reserved items. Investment limit for tiny units is Rs. 25 lakhs.

(c) 749 items are reserved for manufacture in the small scale sector.

(d) Large units are permitted to manufacture items reserved for SSI only after obtaining an industrial license and with a 50% export obligation.

Above restriction is not applicable to 100% Export Oriented Undertakings (EOU), Export Processing Zone (EPZ) or the SEZ units.

5. **Non– Resident Indians Scheme** – FDI policies are applicable to NRIs as well. In addition, special relaxation is available in terms of

(a) NRI/OCB investment in the real estate and housing sectors upto 100%, and

(b) NRI/OCB investment in domestic airlines sector upto 100%.

(c) NRI/OCBs are also allowed to invest upto 100% equity on non– repatriation basis in all activities except for a small negative list.

(d) Apart from this, NRI/OCBs are also allowed to invest on repatriation/non–repatriation under the portfolio investment scheme.

6. **Electronic Hardware Technology Park (EHTP)/Software Technology Park (STP) Scheme**

For building up strong electronics industry and with a view to enhancing export, two schemes viz. Electronic Hardware Technology Park (EHTP) and Software Technology Park (STP) are in operation. Under EHTP/STP scheme, 100% exemption from import duties is available.

7. **Policy for Foreign Direct Investment (FDI)**

Promotion of foreign direct investment is a thrust area of India’s economic policies. Most of the FDI, barring a small negative list, has been put on automatic route without any limit on the extent of foreign ownership.
Some of the recent initiatives taken to further liberalise the FDI regime are –

(a) Opening up of sectors such as Insurance (upto 26%);
(b) Development of integrated townships (upto 100%);
(c) Defence industry (upto 26%);
(d) Tea plantation (upto 100% subject to divestment of 26% within five years to FDI);
(e) Enhancement of FDI limits in private sector banking,
(f) Allowing FDI up to 100% under the automatic route for most manufacturing activities in SEZs;
(g) Opening up B2B e-commerce;
(h) Internet Service Providers (ISPs) without Gateways;
(i) Electronic mail and voice mail to 100% foreign investment subject to 26% divestment condition; etc.

8. **Foreign Collaboration & Technology Transfer** – Reserve Bank of India (RBI) is authorised to give automatic approval to foreign technology agreements and collaborations provided –

(a) Lumpsum payment does not exceed US $ 2.0 million
(b) Royalty is limited to 5% on domestic sales and 8% on exports subject to a maximum of 8% of total sales over a period of 10 years.
(c) Royalty payments should not continue after 7 years of starting of commercial production or 10 years after the date of agreement whichever earlier.

**Incentives offered by state governments to attract industrial investment to the state/certain areas.**

The financial incentives offered by the state governments are generally graded by type of industry and relative backwardness of location in the state. Main incentives are –

(a) **Sales Tax Benefits** – Central / State Sales Tax is either exempt or treated as an interest free long term loan. Maximum amount is decided only by the total investment.

(b) **Investment Subsidy** – Certain specified amounts are given as non-refundable subsidy. The incentive proves to be quite substantial for SSI units. Subsidy amount is treated as owner’s equity by the financial institutions.
Debt– Equity ratio.

(c) Octroi Refunds – Octroi/Entry tax paid to local authority on incoming goods is refunded by state for certain number of years.

(d) Refund of Electricity Duty – Electricity duty is refunded for specified number of years.

(e) Contribution to cost of project feasibility study.

Besides financial incentives, infrastructural facilities that are offered often reduce capital investments and improve profitability –

(f) Setting Up of Industrial Estates providing basic facilities such as power, water, pre– approved land for industrial use, banks, communication and other urban infrastructure.

(g) Availability of Cheap Land – Land is made available at attractive rates which is often far below the actual cost of acquisition and development.

It, therefore, reduces many procedural delays & problems in setting up a new industry and proves to be one of the major factors in deciding industrial location.

Q. Under what circumstances one has to obtain specific government approval for entering into a Foreign Technology Agreement?

Ans. For the following categories, specific Government approval would be necessary–

(a) Proposals attracting compulsory licensing provisions

(b) Items of manufacture reserved for the small scale sector

(c) Proposals involving any previous joint venture, or technology transfer/trademark agreement in the same or allied field in India.

(d) Extension of foreign technology collaboration agreements (including those cases, which may have received automatic approval in the first instance)

(e) Proposals not meeting any or all of the Parameters for automatic approval.

(f) Further, automatic approval for EOU /EHTP /STP units are governed by separate provisions.

Impact of liberalisation on industrial development in India

Liberalisation of Indian economy has changed the industrial scene completely. Following are the key changes in industrial landscape since 1990.
(a) **Capacity Addition/New Capacity Build Up** - The Licence and Permit Raj, that had gagged the growth of Indian Industry till 1990, has gradually given way to almost licence-free state. Removing the licensing led capacity addition/new capacity builds up by Indian companies. This in turn led to increased local competition forcing improved industrial efficiency.

(b) **Shake Down of the Industry** - Many inefficient companies which were surviving on artificially high prices sustained by forced scarcity of goods had to shut down. Many Public Sector companies which could not sustain the competition were sold to private investors for restructuring their functioning.

(c) **Foreign Investment** - Liberal economic policies like full convertibility on current account & limited convertibility on capital account and liberalised EXIM policy have allowed foreign companies to invest in India. Investment came as FDI as well as in financial markets. Foreign companies brought new technologies especially in services sector like banking, communication, entertainment, etc.

(d) **Quality and Cost Improvement due to Foreign Competition**. Entry of foreign companies and reduction in import duty across the board exposed the industry to global competition. Cheap import of Chinese goods at one time posed serious threat to Indian Industry in many sectors. Toys and Locks industries could not match the technological and price superiority of Chinese imports and have got almost wiped out. But rest of the industry has met the competition admirably well and gave the cheap import a run for their money. At the same time, companies have utilised the opportunities to create international market for Indian goods. While imports have grown many fold, so have exports.

(e) **Infrastructure Development** – Poor infrastructure was one of the biggest bottlenecks in industrial development. Poor road, rail, ports, aviation and communication network was affecting price competitiveness of Indian industry. These sectors have received focussed attention of Govt and major improvements have taken place through PPP (Public Private Participation) model.

(f) **Foreign Mergers and Acquisitions** – Indian Companies have developed courage and muscle to seek international growth through M&A route.

*Criteria and advantage of choosing between Sales Tax Exemption Vs Deferred Sales Tax Schemes*

The alternative should to be chosen on the basis of specific advantage to the industry:
In case of sales tax exemption, the firm does not pay any sales tax on its products for a specified duration. If this benefit is passed on to the customers, it results in a direct price reduction of 4% to 10% in the hands of the customer and therefore gives a competitive edge to the product. Although there will be no direct impact on profitability, the option proves beneficial to the firms entering into a competitive market or introducing new products. Else, company may decide to charge at par with other firms and enjoy higher profit margin.

In sales tax deferral scheme, the new firm collects the applicable sales tax from the customer but does not pay it to the government immediately. The amount so collected can be utilised by the industry for financing its working capital requirements or paying back its debts. Since the amount does not bear any interest, the overall financing costs are substantially reduced, resulting in improvement in profitability. The choice of this alternative therefore proves beneficial to established industries setting up expansion projects to fulfil unsatisfied market demand.

Q  What are the eligibility criteria under the current “Industrial Policy’ of the GOI for an industry to be covered under Small Scale Industrial (S.S.I.) Sector? What are the special provisions, concessions, and incentives available to the S.S.I. sector under the policy?

Ans. Eligibility criteria for industry to be covered under SSI sector are–

(a) The investment in Plant and Machinery should not exceed Rs One Crore for ordinary items and Rs 5 Crores for 41 especially reserved items.

(b) Investment limit for tiny units is Rs 25 lacs.

(c) Paid–up capital held by a large industrial undertaking – domestic or foreign – should not exceed 24%.

Special provisions, concessions & incentives available to SSI–

(a) SSI sector is completely exempt from Industrial licensing provisions under the policy.

(b) SSI sector is free from “Locational restrictions” under the policy.

(c) 749 products have been exclusively reserved for manufacture under SSI sector. Any large scale undertaking or a foreign company having more than 24% equity stake can not manufacture these products without undertaking a 50% export obligation.

(d) Bank / Institutional / SIDBI loans are available at concessional rates.

(e) Products manufactured by SSI get priority and price preference in government purchases.


**BUSINESS EVALUATION TOOLS**

Strategising is done at three levels; Portfolio (corporate level), Business Level and Functional level.

1. **Portfolio Strategies** – In a conglomerate (multi business firm), each of the SBUs vie for funds. But which SBU should get how much funds can not be based on any arbitrary process. There are tools to guide the resource allocation across SBUs. These are -

   (a) **B C G Matrix**

   B.C.G. analysis is a technique used in brand marketing and product management to help a company decide what products to add to its product portfolio. It involves rating products according to their market share and market growth rate. The products are then plotted on a two dimensional map.

   B.C.G. Analysis was developed by the **Boston Consulting Group** in the early 1970s.

   ![BCG Matrix Diagram]

   **Assessment of Quadrangles**

   (i) **HH (Stars)** – Businesses which have a high market share and also high growth rate are marked as STARS. They should get additional

   ![BCG Matrix Diagram with HH quadrant highlighted]
resources for further growth. Later, when the growth rate declines, they turn into cash cows.

(ii) **HL (Cash Cows)** – Businesses which have a high market share in a low growth segment. These businesses generate a lot of surplus cash which feed Stars and Question Marks. Such businesses should be allocated moderate resources to maintain the edge but heavy investment should be avoided.

(iii) **LH (?????)** – These are the businesses where market is growing but your market share is low. A "QUESTION MARK" has the potential to become a "STAR" in the future if it is developed. Therefore, allocation of resources should be made selectively and cautiously depending upon potential of the project.

(iv) **LL (Dogs)** – Businesses where there is only limited growth potential and your own market share is also low. These are hopeless cases and it is wiser to divest such businesses. Avoid any allocation of resources.

A company should have a balanced portfolio. This implies having at least one "cash cow" which can generate revenue that can be used to develop one or more "Question Mark". This process is called as "milking your cash cow".

(b) **General Electric’s Stoplight Matrix**

This matrix is a further refinement of BCG matrix. There are six quadrangles instead of four and nomenclature is different. Market share is named business strength and Growth potential is named as Industry attractiveness.

<table>
<thead>
<tr>
<th>Industry Attractiveness</th>
<th>Business Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Invest</td>
</tr>
<tr>
<td></td>
<td>Invest</td>
</tr>
<tr>
<td>Low</td>
<td>Hold</td>
</tr>
<tr>
<td>Medium</td>
<td>Invest</td>
</tr>
<tr>
<td></td>
<td>Hold</td>
</tr>
<tr>
<td>Low</td>
<td>Divest</td>
</tr>
<tr>
<td>Low</td>
<td>Divest</td>
</tr>
<tr>
<td>Low</td>
<td>Divest</td>
</tr>
</tbody>
</table>

(c) **McKinsey Matrix** – McKinsey Matrix is also a two dimension matrix but much more elaborate. The two dimensions are *Industry Attractiveness* and *Competitive Positioning*. Businesses are to be judged on these two criteria based on various factors each of which has been assigned different weights.
2. **Business Level Strategies** – The most famous model for drawing business level strategy is Porter’s Generic Model

**Porter Generic Strategies**- Michael Porter has described three general types of strategies that are commonly used by businesses. These three generic strategies are defined along two dimensions:

(a) **Strategic Strength** is a supply-side dimension and addresses the core competency of the firm: Cost Leadership or Product Differentiation. Please remember that the two strengths are exclusive to each other. Cost leadership and product differentiation do not go hand in hand. Either a company goes cost leadership way or opts for product differentiation. Vi-John (Barbers’ favourites) and Gillette range of saving products are the examples of two strategies.

(b) **Strategic Scope** is a demand-side dimension and looks at the size and composition of the market you intend to target.
In his 1980 classic *Competitive Strategy: Techniques for Analysing Industries and Competitors*, Porter lays down the three best strategies. They are -

- Cost Leadership,
- Product Differentiation, and
- Market Segmentation (or Focus).

While first two are standalone strategies, and exclusive to each other, Market Segmentation, as a strategy, can not stand on its own feet without support of one of the two other strategies. It complements both the other strategies and is necessarily an accompaniment. It has to be adopted irrespective of cost or differentiation leadership. Only scope will differ in two cases.

Combining a market segmentation strategy with a product differentiation strategy is an effective way of matching your firm’s product strategy (supply side) to the characteristics of your target market segments (demand side).

Empirical research on the profit impact of marketing strategy indicated that firms with a high market share were often quite profitable, but so were many firms with low market share. The least profitable firms were those with moderate market share. Porter’s explanation of this is that firms with high market share were successful because they pursued a cost leadership strategy and firms with low market share were successful because they used market segmentation to focus on a small but profitable niche market. Firms in the middle were less profitable because they did not have a viable generic strategy.

(a) **Cost Leadership Strategy**

This strategy emphasizes efficiency. The product is often a basic no-frills product that is produced at a relatively low cost and made available to a very large customer base (*It is assumed that benefits of low cost production are passed on to the customer in the form of low prices. But it does not happen every time. In many cases company continues to charge market rate of product despite substantially low cost of production and uses this advantage strategically*). Cost leadership may be gained through economies of scale, improved capacity utilisation, enhancing productivity, managing upward value chain, etc. Maintaining this strategy requires a continuous search for cost reductions in all aspects of the business.

(b) **Differentiation Strategy**

Differentiation involves creating a product that is perceived as superior to its competitors. The unique features or benefits should provide superior value for the customer if this strategy is to be successful. Because customers see the product as unrivalled and unequalled, the price elasticity of demand tends to be reduced and customers tend to be more brand loyal. (*Pears Soap (Glycerine based transparent) and Dove (with moisturising cream) are two products which have maintained their differentiation for a very*
very long time). This can provide considerable insulation from competition. However, there are usually additional costs associated with the differentiating product features (both glycerine and moisturising cream are expensive ingredients and this could require a premium pricing strategy.

To maintain this strategy the firm should have:

(i) Strong research and development skills
(ii) Strong product engineering skills
(iii) Strong creativity skills
(iv) Strong marketing skills

(c) **Focus (Segmentation) Strategy**

In this strategy, the firm targets a few selected markets, be it demographics or geography or any other parameter. It is also called a focus strategy or niche strategy. It is hoped that by focusing your marketing efforts on one or two narrow market segments and tailoring your marketing mix to these specialized markets, you can better meet the needs of that target market. The firm typically looks to gain a competitive advantage through effectiveness rather than efficiency. It is most suitable for relatively small firms but can be used by any company. As a focus strategy it may be used to select targets that are less vulnerable to substitutes or where a competition is weakest to earn above-average return on investments.
**TOOLS FOR IDENTIFYING INVESTMENT AVENUES**

**Porter’s Five Forces Model**

This model was developed by Michael Porter in 1979. It uses concepts developed in economics to derive 5 forces that determine the attractiveness of an industry/market. It is also known as FFF (Fullerton's Five Forces). These are the forces that have maximum impact on company’s ability to make a profit. A change in any of the forces will require a company to re-assess its business.

These five forces are:

1. Bargaining power of customers,
2. Bargaining power of suppliers,
3. Threat of new entrants,
4. Threat of substitute products, and
5. Level of competition in an industry. (Rivalry among existing players)

![A graphical representation of Porter’s Five Forces Model]

Now let us see when, why and how the 5 forces affect the profitability of a company:

1. **Bargaining Power of Customers**
   
   (a) **Buyer Concentration to Firm Concentration Ratio** – In simple terms, this is demand supply gap. When there is oversupply of product, and many...
competitors for a small group of buyers, buyer has option to switch to other supplier and there is tendency among suppliers to woo the customer through price discounts, gifts etc to garner larger share of the market.

(b) **Bargaining Leverage** – Many customers have leverage over suppliers due to various reasons. There could be host of reasons, like political clout, muscle power, status, locational advantage, etc. Sugar mills have this advantage while buying sugarcane from farmers. Farmers are unable to transport sugarcane to other factories because only one mill is permitted in specified area. Mills often pay the farmers after months and even less than govt rate. Those who insist immediate payments are denied sale. Similarly, malls insist on higher discount on MRP (approx 40% of MRP).

(c) **Volume Buyer** – Customers who are large buyers are often able to bargain better prices. Like almost 50% of P&G’s world wide sales comes from Walmart stores. Therefore Walmart has huge bargaining power with P&G. (For that matter, with any supplier)

(d) **Buyer Switching Costs relative to Firm Switching Costs** – Some times there is substantial cost involved in switching from one supplier to another supplier. Take the cost of telephones. The cost and efforts involved in informing all your contacts of change in your number is huge and is the biggest deterrent in switching your cell number. Thus, once a mobile phone company is able to retain a customer for about 6 months, he is a captive customer thereafter. But once number portability is allowed across telecom service providers, the churn-rate among mobile phone companies will increase substantially.

(e) **Buyer Information Availability** – Information is Power. Once the buyer is aware about inside information of the company, like production cost, customer base, capacity utilisation, material usage, etc, he will bargain from a position of strength. If he knows that you have additional unutilised capacity, he will ask for additional supplies at marginal cost + small profit. Similarly, if he comes to know that your production cost is very low, or you have inventory build up, or your sales are down, he will bargain hard for higher discounts.

(f) **Ability to Backward Integrate** – If the customer has capacity and capability to integrate backward into your business, he will bargain harder with the threat that you will not only lose your business from him but precipitate another competitor as well.

(g) **Availability of Existing Competitive/Substitute Products** – Any one who has easy and at par cost or cheaper access to competitive/substitutes is a tough customer. Take instance of soft drinks. For coke and Pepsi, besides each other, a host of substitutes are available starting with water (yes! Plain cold water and mineral water) to beer, lassi, Nimbu Pani, Jaljeera, etc. That
is why their advertising spend is among the highest in all sectors.

(h) **Undifferentiated Product** – If a product is undifferentiated, a customer will have no difficulty in switching over to another supplier.

(i) **When His Profit Margins Are Low** - Bargains hard to keep his margin intact.

(j) When product is unimportant to him.

2. **Bargaining Power of Suppliers**

   (a) **Supplier Switching Costs Relative to Firm Switching Costs** – Reverse of above.

   (b) **Degree of Differentiation of Inputs** – If a supplier has a well differentiated product, he can command a premium on price. Customer has little choice but to be a victim of such a supplier’s fancy.

   (c) **Absence of Substitute Inputs** – If a product does not have substitutes and there are not multiple suppliers with over capacity of that product in sourcing area, such suppliers will command premium on their product

   (d) Supplier concentration to firm concentration ratio

   (e) Threat of forward integration by suppliers relative to the threat of backward integration by firms

   (f) Cost of inputs relative to selling price of the product

   (g) Insignificance of volume to supplier

   (h) **Cartelisation by Suppliers** – OPEC is an example which keeps adjusting production to keep crude prices artificially high.

3. **Threat of New Entrants**

   (a) **Existence of Barriers to Entry** – Any kind of barriers like cartelisation by existing manufacturers, govt regulations (licences), natural barriers, etc.

   (b) **Capital Requirement** – Capital intensive industries have relatively lesser threat of new entrants since very few people can afford to invest that kind of capital.

   (c) **Economies of Scale** – There are some products which afford huge economy of scale. While the existing players would have slowly grown to build adequate market share/demand, new entrant would have to start with similar capacity without any demand/market to be able to produce at competitive
cost. Maruti could slowly build a network of its service stations and spare parts vendors across India. Any new entrant can not afford to build that kind of network unless they have that kind of density of vehicles on roads and therefore are finding it difficult to compete.

(d) **Brand Equity** – If there is a well entrenched product in the market, it hard for any new product to find a market for itself and therefore discourages new entrants.

(e) **Switching Costs**

(f) **Access to Distribution** – Distribution network is the trump card in the hands of a company. HLL, with its reach to the remotest corner or the country, enjoys that advantage and poses a barrier to the new comers. Many companies, including HLL are known to buy out all the prime shelf and advertising hoarding space ahead of launch of a competing product to black out them in the market.

(g) **Absolute Cost Advantages** – If a firm is enjoying a cost advantage due to any reason, may be captive mines, or pit head location (so low transportation cost) or cheap captive power generation in a power intensive product like metals, it poses hurdle for new entrants.

(h) Learning Curve Advantages

(i) Expected Retaliation

(j) Government Policies

4. **The Threat of Substitute Products**

(a) Buyer Propensity to Substitute

(b) Relative price Vs performance of substitutes

(c) Buyer switching costs

(d) Perceived level of product differentiation

5. **The Intensity of Competitive Rivalry**

(a) **Number of Competitors** – Higher the number of competitors, higher the struggle for the market share. Bigger group also brings in ego clashes leading to indiscriminate poaching even at otherwise prohibitive costs.

(b) **Rate of Industry Growth** – This happens in later stages of product life cycle when product demand begins to stabilise or even decline after peaking while new entrants continue to set up additional capacities without observing the
life cycle stage of the product, leading to overcapacity

(c) **Intermittent Industry Overcapacity** – It is again a common phenomenon. Many people who catch the cyclic demand late end up adding capacity when demand begins to ebb. Thus, there is huge overcapacity during lean demand period. This phenomenon is most prominent in agriculture. One season, there will be scarcity of say pulses and therefore very high prices. In the very next year, the prices will not be adequate even to recover the costs due to over supply from increased acreage of cultivation pulses. Having suffered huge losses, farmers will switch the crop next year and there will be scarcity of pulses once again and the cycle continues.

(d) **Exit Barriers** – If exist routes are not available, existing players will continue to attempt to garner larger market share through price cuts or discounts etc.

(e) **Diversity of Competitors** – Rivalry becomes intense with diversity of competitors. Say, a product is being supplied by manufactures from across the world (take for instance BPO services). Each supplier has a different cost advantage, different problems, different govt policies, and so on. On the other hand suppliers have no common forum to meet and plan their strategy against arbitrary damaging actions by individual player.

(f) **Informational Complexity and Asymmetry** increases distrust and rivalry.

(g) **Thin Profit Margin Products** – Rivalry is intense when profit margins are already thin since only way out to increase profits is by increasing sales. Imagine the intensity of competition in salt business. Consumption can not be increased in any way (Probably this is the only product in the world whose consumption can not be increased). Profit margins are thin (Govt would not want a Dandi March by a new born Mahatma). What growth strategies can the salt manufacturers follow but to snatch each other's market share? (But Catch salt did it by differentiation and packaging)

(h) **Lack of Product Differentiation** – If there is no real avenue for product differentiation, like in case of soft drinks, rivalry increases.

Though not supported by all, some argue that a 6th force should be added to Porter's list to include a variety of stakeholder groups from the task environment. This force is referred to as "Relative Power of Other Stakeholders". Some examples of these stakeholders are governments, local communities, creditors, shareholders, employees, & so on.

Not every industry faces all the forces. Some industries face as low a two while some other might face all the five. Again the intensity of individual forces will vary with industry. Your job is to identify the forces and find a position where the sum total effect of all the forces is minimum.
Criticism

Porter's framework has been challenged by other academics who have raised objections to underlying assumptions in the model, viz -

(a) That buyers, competitors, and suppliers are unrelated and do not interact and collude

(b) That the source of value is structural advantage (creating barriers to entry)

(c) That uncertainty is low, allowing participants in a market to plan for and respond to competitive behaviour.

Profit Gap Analysis: To establish where the company is going in terms of profits. Many times in the battle to gain market share, price cuts reach levels where profitability falls into negative. Also to see if a gap exists between desirable profit targets and level of profits which existing products can contribute to the target.
NEW PRODUCT IDEA GENERATION TECHNIQUES

Why do the companies scout for new project ideas?

Following are some of the basic reasons for companies to look for new project ideas

(a) **Growth** – Organisational ambitions and aspirations for growth – to be a local / state / national / global player; to be a market leader etc.

(b) **Competition** – Increased competition in existing product market.

(c) **Product decay/Obsolescence** – Product substituted / not required any more.

(d) **Technology Obsolescence** – Existing product’s competitiveness eroding due to new and cheaper technology available.

(e) **Government Policy** – Changes in government policy, tax structure may necessitate withdrawal of product.

Systematic steps to be followed while choosing a new project idea –

(a) **Establishing Policy** – Policy arising out of corporate vision and mission & resulting in a long term strategy for company’s strength.

(i) Define company’s objectives

(ii) Set growth goals through profit gap analysis

(iii) Decide tentative direction

(b) **SWOT Analysis** of company

(c) **Demand Assessment**

(d) **Selection of Market** – Identify potential markets that are in line with company’s objectives and policies are assessed & short listed.

(e) **Detailed Market Survey** – To establish demand, pricing, probable market share, establish distribution strategy etc.


(g) **Risk Assessment** – Understanding and assessment of present & future market risks.
Development of a new product idea usually is not a result of a process that is completely rational. It is similar to scientific research where the investigator starts with existing knowledge and proceeds by a mixture of reason & imagination. The final creative leap is not fully under control, but it comes as a burst of inspiration.

**Methods of Idea Generation**

1. **Ideas from Overseas**
   - (a) Travelling abroad
   - (b) Examination of foreign literature
   - (c) Employing free-lance scouts
   - (d) Information from subsidiaries & sister companies

2. **Specialised Market Research Techniques**
   - (a) Repertory grid technique
   - (b) St. James model
   - (c) Gap analysis
   - (d) Non-metric mapping

3. **Ideas from Company Employees**
   - (a) Company suggestion scheme
   - (b) Employee panel
   - (c) Invention groups
   - (d) Think tanks
   - (e) Job rotation
   - (f) Circulation sheets
   - (g) Past ideas & projects

4. **Ideas from Company Sales Force**
   - (a) Contests
   - (b) Report forms
   - (c) Ideas at sales meetings
   - (d) Group discussion & depth interviews

5. **Ideas from Outside The Company**
   - (a) Inventors
   - (b) Patents
(c) Licensing  
(d) Joint ventures  
(e) Acquisitions  
(f) Suppliers  
(g) Student projects  
(h) Sponsored research  
(i) Consultants  
(j) Advertising agency  

6. **Product Oriented Techniques**  
   (a) Product checklists  
   (b) Attribute listing  
   (c) Value analysis  
   (d) Morphological analysis  
   (e) Scimitar technique  
   (f) Forced relationships  
   (g) Letters of complaints  
   (h) Recipe books & menu cards  

7. **Creativity Oriented Techniques**  
   (a) Brainstorming  
   (b) Synectics  
   (c) Lateral thinking  

8. **Consumer Oriented Techniques**  
   (a) Group discussions  
   (b) Consumer panels  
   (c) Pseudo product tests  
   (d) Depth interviews  
   (e) Activity analysis  
   (f) Past consumer research  

9. **Competition Oriented Techniques**  
   (a) The me-too approach  
   (b) Trade opinion surveys  
   (c) Market analysis  
   (d) Store visits  

10. **Other Specialised Techniques**  
    (a) Technological forecasting  
    (b) Segmentation analysis
PROJECT APPRAISAL

Facets of Project Analysis

1. **Market Analysis** – Assessing as to what would be aggregate demand of proposed product/services in the future? What would be the market share of the product under appraisal?

2. **Technical Analysis** – A very wide gamut is covered in this analysis
   
   (a) Preliminary tests – like prototype
   (b) Production processes and equipment
   (c) Availability of raw material, labour, power and other inputs
   (d) Waste management – Toxic effluents management, etc.
   (e) Location selection
   (f) Social acceptance

3. **Financial Analysis**
   
   (a) Cost of project / Investment Outlay (progressive requirement of funds)
   (b) Means of financing
   (c) Cost of capital
   (d) Cash flows assessment
   (e) Break-even point assessment
   (f) Profitability assessment
   (g) Risk assessment
   (h) Investment worthiness
   (i) Projected balance sheets.

4. **Economic Analysis** – It is judging the project from social point of view, the analysis of social costs and benefits, like, jobs it will generate, effect on pollution, convenience of masses, environmental effects, etc. (A bridge, besides earning revenue for builders, generates jobs for people (directly for people employed in construction and indirectly for people employed in cement and steel industry), gives convenience to people, saves precious fuel and time for people, saves foreign currency for govt (through savings in fuel), improves environment due to reduced fuel consumption, and so on). Some of the special questions that are analysed are –

   (a) What is the social cost-benefit equation in terms of shadow pricing and not market prices (Shadow price is the price which would prevail in a perfect market).
(b) How will it affect the market price of the product? Will it make the product more affordable? Additional capacities may bring down the prices in the market.

(c) Will it affect any other segment of industries? Many small scale industries are adversely affected by the larger projects due to economies of scale enjoyed by bigger projects.

(d) Will it trigger further investments? Bigger projects kick start lot of supporting economic activities in the vicinity, starting from the tea vendors and hutment grocery stores to schools and so on.

5. **Ecological Analysis**

(a) What are the likely damages caused by the project to the environment?

(b) What is the cost of minimising the damages to bring them down to acceptable limits?

6. **Managerial Appraisal** – Good execution can make a bad idea profitable but an excellent idea can not survive bad implementation. Success of any project eventually rests in the hand of the managers of that project. Managerial capability of promoters is judged by their resourcefulness, their understanding of the project details and their commitment to the project.
**FINANCIAL APPRAISAL**

Financial appraisal is meant to assess the financial viability of a project. In case of Infrastructure Projects like highways, dams, power projects, bridges, etc, economic appraisal is the decisive factor and financial appraisal takes the back seat. But in case of commercial projects, financial viability is paramount justification for undertaking the project. A project should be able to generate adequate ROI to cover the opportunity cost of capital. Unless this requirement is met, a commercial project is a non-starter.

**Scope of Financial Appraisal**

(a) Initial Investment outlay  
(b) Subsequent investment outlay  
(c) Economic life of project  
(d) Operating cash flows  
(e) Cost of funds  
(f) Opportunity cost of funds  
(g) Rate of taxes  
(h) Depreciation  
(i) Salvage value

**Methods and Techniques of Financial Appraisal**

1. **Non Discounting Methods**

   In general, the non-discounting methods are simpler to calculate and therefore give a quicker comparison between various proposals. They, however, do not take *Time Value* of future cash flows into consideration and therefore may result in misleading conclusions. These criteria are therefore used to compare smaller investments or as a quick, back of the envelope, method to discard weak proposals.

   (a) **Pay Back Period** –

   This is the simplest of all the methods but most inaccurate too. It is the period by which investments are expected to be recovered. In technical terms, net cash flows (Profits after tax) are equal to the investment. **Pay Back Period** is the length of time to recover initial cash outlay on the project. Shorter the payback period, more attractive the project. But this
method suffers from some serious lacunae. Cash flows after the pay back period are completely ignored thus distorting the conclusions sometimes.

Say, you get a profit of Rs 20,000 per year on an investment of Rs 1,00,000. It will be 5 years before you cumulative profits are equal to your investment. So, we say that pay back period is 5 years. *(But, what about the interest that we will have to pay to the bank?)*

Now take two cases; one where entire Rs 1,00,000 comes back at the end of fifth year and second where Rs 90,000 comes back after 1 year and Rs 10,000 comes back at the end of 6\(^{th}\) year. You don’t need to be an MBA to know that second option is better. But as per payback period method, first method is better since it pays back the investment in 5 years compared to 6 years in second case.

(b) **Accounting Rate of Return**

It is a measure of project profitability that relates income to investment, both measured in accounting terms. It is generally expressed as a ratio of Average Income after Tax to Initial Investment.

**Disadvantages**

- Time value of money is ignored
- Cash inflows / Outflows after payback period are ignored.

2. **Discounting Based Criteria** –

(a) **Discounted Cash Flow (DCF) or NPV Method** –

*Net Present Value (NPV)* is the sum of the present values of all cash flows associated with the project. Future cash flows are discounted at a certain hurdle rate to arrive at their present value. Higher NPV indicates a better proposal in case the Initial Investments are similar. *(If initial investments are not similar, higher investment will probably yield higher net income though it may be at lower rate)*.

It considers time value for money. As a result, earnings in earlier years have higher value than those earned in later years. Cash inflow and outflow for the entire life of the project is considered, inclusive of terminal/salvage value. All future earnings are discounted at the rate of cost of capital. If I expect to get Rs 1000 five years from now, I will not take full Rs 1000 into account but only the amount which, if deposited in bank at the interest rate of cost of capital, will fetch me Rs 1000 after 5 years. So, the formula for compounded interest is
Total Sum = Principal Sum \times \left(1 + \frac{r}{100}\right)^n

So, Principal Sum = \frac{Total Sum}{\left(1 + \frac{r}{100}\right)^n}

If Total Sum is Rs 1000 after 5 years and interest rate is 10% then

Principal Sum = \frac{1000}{\left(1 + \frac{10}{100}\right)^5} = \frac{1000}{(1.1)^5} = Rs 620.92

Thus, an amount of Rs 1000 which I expect to get after 5 years is valued today at Rs 620.92 only and will be taken as such for calculations. If the income from a project is for 5 years, then each year’s income will be discounted by cost of capital (interest rate) for all the preceding years and total income found at today’s value. Let us find out how much is the Present Value of Rs 1000 received every year over next 5 years if interest rate is 10%.

Present Value = \frac{1000}{(1.1)^1} + \frac{1000}{(1.1)^2} + \frac{1000}{(1.1)^3} + \frac{1000}{(1.1)^4} + \frac{1000}{(1.1)^5}

= 3790.79

A direct formula for this is PV = \frac{1}{r} \left[ 1 - \frac{1}{(1 + r)^n} \right] \times \text{yearly cash flow}

(Above formula is valid only if cash flow and interest rate each year are constant. In case cash flow varies year by year, then earlier method is to be used. In case the interest rate varies year by year, the formula will be modified).

Suppose, in the first year, the interest rate is 10% and income Rs 1100, in second year it is 12% and Rs 1250 and in the third year it is 11% and Rs 1300. In such a case, present value of three years earnings will be

Present Value = \frac{1100}{(1.1)^1} + \frac{1250}{(1.1 \times 1.12)^2} + \frac{1300}{(1.1 \times 1.12 \times 1.11)^3}

= 1000 + 1014.61 + 950.62

= Rs 2965.23
So, we calculate today’s value of all future earnings which gives us *Present Value*. Then we subtract the investment that is required to be made in the project. What remains is the *Net Present Value* of that project. If this is positive, project is worthy of investment.

This is one of the popular methods for financial viability assessment. However, it gives a distorted picture when two projects for comparison involve widely different initial investment. (Project with higher initial investment will normally show higher Net Present Value even though ROI may be lower).

(b) **Benefit – Cost Analysis**

It is a modification over NPV method. It takes away the limitation of matching initial investments. It calculates the ratio of either "Present Value" to the Initial Investment (Benefit Cost Ratio - BCR) or the "NPV" (Net Present Value) to Initial Investment (Net Benefit Cost Ratio - NBCR). Therefore, this method gives the NPV as percentage of investment. Thus, this criterion is preferable to NPV criteria, especially for comparing proposals having widely differing initial investments.

(c) **Discounted Payback Period Method**

In this method, future earnings are discounted to present value like in case of DCF/NPV method and then the payback period is calculated. This corrects the most glaring deficiency of this method. However, second major deficiency, ie, the cash inflow/outflow after payback period which is ignored, remains uncorrected.

(d) **Internal Rate of Return (IRR)**

It is the discount rate at which NPV of the project is Zero. Higher the difference between IRR and hurdle rate, better the proposal irrespective of the amount of initial investment.

IRR is that rate of discount at which the net present value of cash inflows equals net present value of cash outflows. In simple words, it is that discount (interest) rate at which NPV of all future income becomes Zero. It means, PV of all future earnings is equal to investment on project. This is often done by hit and trial. The project for which IRR discount rate is highest is chosen.

If IRR > COC Investment is support worthy. This method is almost as good as NPV method.

But even NPV and IRR methods suffer from some lacunae

NPV method takes final net profit into account without considering rate of return on
investment. Take for instance three proposals; First – Investment Rs 1,00,000 with of NPV Rs 10,000; Second – Investment Rs 50,000 with NPV of Rs 8,000; Third – Investment Rs 40,000 with NPV of Rs 7,000. NPV method will recommend first without considering that we have option of taking in second and third options together with a total investment of Rs 90,000 and total NPV of Rs 15,000.

Similarly, IRR will give preference to Rs 40,000 project giving an internal rate of return of 17.5% (Rs 7,000 NPV) over a Rs 1,00,000 project with IRR of 10% (Rs 18,000 NPV). What if there is no productive avenue to invest balance Rs 60,000?

Thus, these methods will only make the picture a little clearer. Total dependence on any one method is not ideal strategy. There are other factors which need to be considered before taking any investment decision, like funds availability vis a vis other investment avenues, risks, growth, company’s core competencies, portfolio balancing, etc.

Discounting methods are considered to be more dependable for comparing large investments and are recommended for use by the financial institutions.

Q. **Discuss the relative merits & demerits of N.P.V. & I.R.R. criteria for evaluation & comparison of investment proposals.**

**NPV Method –**

(a) Since NPV method gives Net value of returns in Present Rupee terms, NPVs of different projects can be directly added. This helps in deciding the projects that can be accepted amongst several contenders under limited funds situation.

(b) Since NPV gives net value of returns in absolute Rupee terms, it cannot be used to compare projects that require different initial investments.

(c) Ranking of projects by NPV method is influenced by nature of cash flow patterns & discount rates. Projects with similar initial investments give different rankings at different discount rates.

(d) The method also does not indicate the risk margin available over the hurdle rate or the cost of capital.

**IRR Method –**

(a) IRR indicates margin of safety over cost of capital.

(b) Ranking of projects can be done for projects with different initial investments.
(c) Ranking of projects does not change with change in cost of capital.

(d) If cash flows change sign more than once, there can be multiple values for IRR.
MARKETING APPRAISAL

Main aspects of ‘Market Analysis’ while working out the project feasibility

Main aspects to be considered under market analysis while working out the project feasibility are—

(a) **Product Features** – Major uses, scope of market, possible competition from substitute products, special features resulting in consumer preference.

(b) **Product Demand** – Past & present demand, forecast of future trends, market segmentation by nature of product, consumer groups, geographical division etc, other demographic, sociological, economical, technological factors affecting demand.

(c) **Market Share** – Expected market share and its growth from the projected demand

(d) **Product Pricing** – Price trends in the past, income and price elasticity of demand

(e) **Export Possibilities** – Nature of competition in foreign markets, competitive pricing & costing

(f) **Distribution & Sales Promotion Methods** – Distributors, selling agents, selling organization for direct selling

(g) **Government Controls** – Government controls on pricing, distribution, imports, exports if any.

The main outputs of market analysis useful for financial analysis are –

(a) Forecast of sales quantities based on demand projections, expected market share and their growth

(b) Projected selling prices

(c) Factors affecting demand / prices and their possible ranges of variation.
Limitations of Trend or Time Series analysis methods in demand forecasting

Trend or time series analysis method is not an appropriate approach to use in a new product/ new business situation, or in situations where circumstances have radically changed, and the past is no guide to the future. Since the underlying processes producing the forecast have changed, it is unwise to assume any continuity of events. There is always possibility of overlooking some fundamental change in the process.

Whenever there is major change in the environment, such as a competitor introducing a radical new product, extrapolative forecasting methods become less appropriate. Trend analysis methods are also not appropriate where relevant historical data is not available. Nor are they appropriate where the historical data is unreliable, perhaps because it has not been recorded in a consistent manner over the relevant time period. Also, it is necessary to ensure comparability of data; like using sales values instead of volumes will neglect the effect of inflation. Also, when a company sells a range of products or services and that mix has changed over time, extrapolation of values would be misleading.

The forecasting methods to be used in such circumstances are –

(a) **Chain Ratio Method** – Potential sales are estimated by applying a series of factors to a measure of aggregate demand.

(b) **Consumption Level Method** – For products that are directly consumed, the consumption level is estimated on the basis of elasticity coefficients – income elasticity and price elasticity of demand.

(c) **End Use Method** (a.k.a. Consumption Coefficient Method) – Suitable for estimating demand for intermediate products that are consumed for various end uses. Estimate is based on estimated output levels of various end use products and proportion of use of concerned intermediate product in those.

(d) **Leading Indicator Method** – Leading indicators are variables that change ahead of its dependant or lagging variables. Observed changes in leading variables are used to predict changes in lagging variables.

(e) **Econometric Method** – Econometric model is mathematical representation of economic relationships derived from economic theory.
Main aspects to be considered in technical analysis of a project.

Technical analysis of the project is concerned primarily with the following–

1. Manufacturing Process & Technology – Appropriateness of the chosen technology and manufacturing process among various alternatives is ascertained. What is the level of automation and flexibility for changing process/product at a later date.

2. Material Inputs – Availability and cost of raw materials, power, and other facilities like utilities, etc is assessed.

3. Plant Capacity and Product Mix – Plant Capacity has a bearing on cost of product and outlay. Can the capacity be cross deployed for changing product mix to be able to respond to changed market conditions.

4. Machinery & Equipments – It is dependant on production technology, process and plant capacity. Whether new machines to be installed or second hand machines to be fitted? A proper balance has to be obtained between capacities of individual sections or production departments.

5. Production System and Plant Layout – Plant Layout is guided by Production System to be followed. Whether flow process, batch process, cellular process or project process are being used.

6. Location and Site – Choice of location is decided by factors such as proximity to raw materials and markets, availability of skilled labour and infrastructure, government incentives etc. Specific site or plot to be selected on the basis of its suitability and cost to develop the same for the particular industry.

7. Buildings and Structures – Any special requirements for structures to be considered. Areas for manufacturing, services, utilities, administration, welfare etc. to be planned.
NETWORK DIAGRAMS

Any project is a set of activities and those activities need to be performed in a particular sequence. Most activities will have dependence on some other activity. You can not start construction of roof till pillars/wall have been build. Similarly, you can not start painting the building unless all masonry work has been completed. A network diagram establishes this inter-relationship and dependencies between activities. PERT (Programme Evaluation and Review Technique) and CPM (Critical Path Method) are the methods used to draw the network diagrams.

The two methods are quite similar like twins. (There are some minor differences that we will see shortly) For long they have been referred to in the same breadth. Therefore, they have been merged and called Network Diagram Technique.

PERT

PERT as a method is applied to research and development oriented projects where many activities do not have precedents on the basis of which their likely duration can be estimated. It deals with the uncertainties involved in performing various activities and therefore, difficulties in determining exact duration of activities in the project. Hence, the model adopts a statistical weighted average time estimate based on three time estimates – optimistic, pessimistic and most likely times – criteria. The total project duration worked out on this basis thus also has certain probability value.

CPM

CPM approach is applied to more routine nature work situations and therefore, considerable amount of past data is available for similar activities. The activity durations can be estimated with a fair accuracy. The total time for completion based on critical path duration is also quite accurate and helps in controlling the project schedules more effectively.

Thus the two methods essentially differ in their time estimation techniques for various activities. But once the time for each activity has been estimated, remaining process is same. We draw the network diagram, find the minimum project duration and some other calculations as required from the network diagram.

But how do you know that the schedule worked out for 30 days is the best possible and most economical schedule? Or how much extra cost will be required for reducing this schedule by say 5 days. Will that be beneficial for overall project implementation? These are some of the most common questions that every project manager is required to answer satisfactorily. CPM (Critical Path Method) helps the manager to answer these questions.
**Drawing the Network Diagram**

A network diagram is a maze of circles and arrows with some numbers written all over. But these circles, arrows and numbers follow certain conventions.

Network Diagrams are drawn in two ways: AON (Activity on Node) and AOA (Activity on Arrow). We will be generally following the second method in these notes except for demonstration of AON method. However, AON is superior to AOA method since it carries more information in the diagram.

**AOA Method/Arrow Diagramming Method**

**Some Ground Rules**

1. Each arrow represents one activity.
2. An arrow is drawn starting and ending in events represented by circles, called nodes. Length of an arrow is not drawn to any scale does not represent time for activity.
3. The arrow is pointed towards finishing event.
4. Circles (in the form of old TATA insignia) are called *Nodes or Events*. Nodes only signify start or end of an activity or event. They do not consume any time.
5. Nodes are numbered serially as 1, 2, 3, …… inside the top half of circle.
6. Nodes are normally numbered left to right serially and an earlier event has lower number than an event occurring later (Though this rule is not sacrosanct and deviations are allowed).
7. Nodes are connected by unidirectional arrows ( → ). These arrows represent “Activities”.
8. Activities are named either by alphabets (A, B, C, D, ----) written on top of arrow or
by numbers of preceding and succeeding nodes (1-2, 2-4, 3-4, etc).

9. More than one activity can start or terminate on one node (Activity C & E have started from node 3. Activities B, D & E have terminated on node 5).

10. Any two nodes can be connected by only one activity. No two nodes can be connected by two or more activities.

Diagram - 2

But in real life such situations do exist. In case two activities, say C&E, in the diagram 2 start from the same node 3 and are required to finish on node 5, which is not allowed. Then one of the activities, say, activity C, is then terminated on a separated node 4. A dummy activity D, which consumes zero time, is created (refer diagram 1). It starts on completion of C and is terminated on node 5. This dummy activity is marked by broken line.

11. For the sake of convenience, arrows can be drawn in any direction. There can be bent also, like in activity F above.

12. There can be more than one starting nodes, like nodes 1 and 2 above but only one finishing node.

13. Number in the upper half of the node (2) is the **Node Number**.

14. EST and EFT are calculated by working with numbers from starting activity to finishing activity (Forward Pass). While LST and LFT are calculated by working backward from last node to first node.

15. Critical Path is the longest path in the network diagram. There is no Slack or Float available for the activities on Critical Path. Any delay in completion of critical path activities will manifest in delay of project completion.
Significance of ‘Total’, ‘Free’ and ‘Negative’ floats.

There are three kinds of floats; Total Float, Free Float and Independent Float.

1. **Total Float** – It is the float under most favourable condition. Total float signifies the extent to which an activity completion can be delayed without affecting the final completion date. If we start the activity at the earliest (EST) and finish at the latest possible time (LFT), then the extra time that we had is Total Float. Mathematically, it is LFT – EST – Duration of activity.

2. **Free Float** – It is the extra time that is available when the activity is started at EST and finished at the EST of next activity. It is therefore calculated as the difference between Late Start and Early Start for an activity (LS– ES) Or the difference between Late Finish and Early Finish (LF– EF) Or (LF– ES– duration). It is useful to know the free float when the responsibility for the successor activity lies with another agency and one cannot disturb its schedule in any manner.

3. **Independent Float** – This is the float available under the most adverse conditions, i.e., the activity is started at the LST and finished at EST of the next activity.

Thus, independent float for an activity may be negative, but total float and free float can not be negative. They can be zero at the worst. *(Activities on the critical path have no float).*

**Negative Float** for an activity means that the time available to carry out the activity is less than the time required to complete the same. When the project is to be completed by a given deadline and critical activities are delayed, the negative value of float indicates the extent to which the activities are required to be crashed in order to meet the deadline.

**Q.** Define ‘Critical Path’ in a CPM network. How is it significant for project control? Does the critical path once identified, remain same till completion of project? If not, what are the reasons for its change?

**Ans.** Critical path is the longest path in a CPM network. It is the sequence of activities from the starting activity to the finishing activity, with value float equal to zero. The activities on the critical path are known as critical activities and they must be completed within the time allotted without any delay so that the project could be completed within scheduled time. Any delay in performing critical activity will delay the project completion by same time. It is therefore necessary to focus the attention and efforts, give priority in allocating resources to critical activities to ensure their timely completion. It may also be necessary to ‘crash’ the critical activity duration by spending extra resources either to avoid delay or to optimise overall project costs.
The critical path (or paths) once identified at the beginning of the project, does not remain same till completion of the project but is likely to change or shift at the time of every project update. While the project is under progress and a periodic review is carried out, it is often observed that the actual time taken for completion of various activities is different from their estimated time for completion. It happens that while some critical activities get completed before their scheduled time, some non-critical activities get delayed even beyond the entire ‘float’ available. Such situations result in change of ‘float’ values of activities and therefore emergence of a new critical path.

Example – Referring to the list of activities below, draw a network in Arrow Diagram (AOA) convention. Find out the total time for project completion, critical path and total floats available on non-critical activities. (First three columns drawn in Bold borders are the information provided in the question and balance information has been worked out).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration (D)</th>
<th>Immediate Predecessor</th>
<th>Successor</th>
<th>Forward Pass</th>
<th>Backward Pass</th>
<th>Total Float</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EST</td>
<td>EFT = EST + D</td>
<td>LST</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>-</td>
<td>B, C</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>A</td>
<td>D</td>
<td>3</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>A</td>
<td>E, F</td>
<td>3</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>B</td>
<td>G</td>
<td>8</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>E</td>
<td>6</td>
<td>C</td>
<td>G</td>
<td>10</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>F</td>
<td>4</td>
<td>C</td>
<td>H</td>
<td>10</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>G</td>
<td>5</td>
<td>D, E</td>
<td>H, K</td>
<td>16</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>H</td>
<td>8</td>
<td>G, F</td>
<td>L</td>
<td>21</td>
<td>29</td>
<td>21</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>G</td>
<td>L</td>
<td>21</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>L</td>
<td>4</td>
<td>H, K</td>
<td>-</td>
<td>29</td>
<td>33</td>
<td>29</td>
</tr>
</tbody>
</table>

The path drawn in RED (double lines) is the critical path since There is no slack available in this path. EST and EFT in all cases are same.
Forward Pass / ASAP / Early Start Schedule
For activities without predecessors, Earliest Start Time (EST) = ‘0’
Earliest Finish Time (EFT) = EST + Duration (D)
EFT of predecessor = EST of successor
   = maximum / later / highest of EFTs of predecessors, if there are more than one predecessors (Please remember that a successor activity can start only after last of the predecessor activities have finished. That is why highest time activity is taken into account. Compare path B,D and C,E. For Node 5, EFT by B,D route is 3+5+4 = 12 and by C,E route it is 3+7+6 = 16. So, we take 16 which is higher of the two).

T = project completion time = maximum / latest, highest of EFT

Backward Process / APLAP / Late start schedule
For last activity, LFT = EFT (Remember there is only one last activity)
LST = LFT – D
LFT = LST of successor
LFT = Minimum / Earliest / Earlier of LST of successors when more than one successors are involved (Remember this is reverse of forward pass where we took maximum/latest/highest EFTs of predecessors)

TF = Total Float
   = LFT – EFT or LST – EST
   = Total time available – time required
   = LF – ES – D (T, being common letter, is some times omitted while writing)
The activities for which total float is ‘0’ are critical activities. In this case they are:
   A – C – E – G – H – L

Critical path goes from the beginning of the project till the end.

Total project duration = 3 + 7 + 6 + 5 + 8 + 4 = 33 i.e. duration of individual activities

Now to find the Free Float

Free Float = EST of successors – EFT (lowest of ES if more than one successors)
   = TF of successor – TF

Working out timings for events (We have so far been working with Activity timing):
- early occurrence time (EOT)
- late occurrence time (LOT)

Event Slack = LOT – EOT
Slack = property of event
Float = property of activity
Note – CPM depends on float
Total Float = LOT of Head – EOT of Tail – Duration
Crashing

‘Crashing’ is a process of reducing the normal estimated duration of an activity by adopting a more efficient process, equipment or person at an ‘Extra Cost’.

It is often possible to complete an activity faster than normal. You go to get your passport made. Normal time required is 6 weeks and cost is Rs 1000. But if you get it made under Tatkal scheme, you can get it in two weeks but the cost will increase two and half fold to Rs 2500. Thus, there is a Time and Cost Trade Off. In Network parlance, it is called Crashing.

Sometimes, it is beneficial to spend extra money and reduce the activity time. Overall saving may be higher than the cost incurred, say, through incentive money for completing the project by a certain date or avoiding a hefty penalty/LD for overshooting the deadline. A project has hundreds of activities and cost of crashing of each activity is different. Obviously, we would like to crash an activity whose cost of crashing is minimum.

Pre-requisites – cost of resources, time should be accurate.

Q. Why is the time-cost trade off relationship important in deciding the ‘optimum’ duration of the project? Explain with a suitable diagram.

Ans. ‘Crashing’ is also called Time-Cost trade off. It is a process of reducing the normal estimated duration of an activity by adopting a more efficient process, equipment or skills at an ‘Extra Cost’.

Total project cost comprises of the ‘direct cost’ for performing activities (material, labour & machinery costs, equipment hire costs, etc) and ‘indirect cost’ (overheads, supervision, interest, down time cost, loss of revenue etc). It is observed that while the indirect costs are directly proportional to the project duration, the direct costs are inversely proportional to activity duration (average time). This means that the indirect costs reduce with the project duration while an extra expenditure has to be incurred on activities to reduce their duration. In order to optimise the project cost it is necessary to find a balance between the cost savings due to reduction in indirect costs and additional direct costs due to reduction of activity duration.

The project duration at which the project costs are minimum is therefore known as ‘optimum’ duration. This is illustrated in the following diagram–
Q. **Explain the circumstances when ‘Crashing’ of activities is considered necessary. Why the concept of ‘crashing’ cannot be adopted for PERT methodology?**

**Ans.** The critical path of the CPM network gives the minimum time and therefore, the earliest date, to complete the project under normal circumstances. It is often possible to reduce the total project duration by resorting to ‘crashing’ the critical path activities i.e. reducing the expected duration by assigning extra resources or adopting more efficient processes. Crashing is considered necessary under the following circumstances–

(a) If it is required to complete the project before the date indicated by the critical path, it becomes necessary to complete the activities on critical path before their estimated times.

(b) If the project is delayed during the process of implementation, crashing is done to meet the project deadline to avoid heavy penalties, cancellation of order, loss of goodwill, etc.

(c) Crashing is also done to optimise project duration to minimise total project cost. This is done by achieving a balance or trade-off between project’s direct & indirect costs vis-à-vis project duration.

PERT methodology uses probabilistic time estimates for activity durations and the activity costs are also not very certain. Even the longest path identified in the network may not be the real critical path if another ‘near critical’ path has higher variability (i.e. Standard Deviation). Under such circumstances, it is not possible to consider crashing as precise information on timings and costs can not be obtained.
**Q.** Following are the details of activities in a project –

<table>
<thead>
<tr>
<th>Activity</th>
<th>Predecessor</th>
<th>Normal</th>
<th>Crash</th>
<th>Crash cost / day</th>
<th>Tally</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>9</td>
<td>6</td>
<td>30,000</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>8</td>
<td>5</td>
<td>25,000</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>-</td>
<td>15</td>
<td>10</td>
<td>30,000</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>A</td>
<td>5</td>
<td>3</td>
<td>10,000</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>B</td>
<td>10</td>
<td>6</td>
<td>15,000</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>C, D, E</td>
<td>2</td>
<td>1</td>
<td>40,000</td>
<td>4</td>
</tr>
</tbody>
</table>

Indirect cost = 60,000/- per day. Find the optimum duration for the project?

Find the critical path:

- **Normal**
  - \( P_1 = ADF \): \( 9 + 5 + 2 = 16 \)
  - \( P_2 = CF \): \( 15 + 2 = 17 \)
  - \( P_3 = BEF \): \( 8 + 10 + 2 = 20 \)

- **Crash**
  - \( P_1 = ADF \): \( 6 + 3 + 1 = 10 \)
  - \( P_2 = CF \): \( 10 + 1 = 11 \)
  - \( P_3 = BEF \): \( 5 + 6 + 1 = 12 \)

\( \therefore \) \( P_3 \) is the critical path.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Crash By</th>
<th>( P_1 ) ADF</th>
<th>( P_2 ) CF</th>
<th>( P_3 ) BEF</th>
<th>Extra Cost</th>
<th>Saving</th>
<th>Net saving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>16</td>
<td>17</td>
<td>20*</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>(15)</td>
<td>16</td>
<td>17*</td>
<td>17*</td>
<td>15x3 = 45</td>
<td>180</td>
<td>135</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>40x1 = 40</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>C + E</td>
<td>(30 + 15)</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>45x1 = 45</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>D + C + B</td>
<td>10 + 30 + 25</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>65x1 = 65</td>
<td>60</td>
<td>65 = (05)</td>
</tr>
</tbody>
</table>

Step 1 - Find critical path = \( P_3 \) = 20 days

---

*Page 47 of 107 - Project Management (Ver1.1 - 09/03/2007)*

*Jamnalal Bajaj Institute of Mgmt Studies*
Step 2 - Select the minimal cost activity in critical path. In this case, it is E which costs Rs. 15,000/- per day.
The second most critical path is P2 which is 17 days; therefore, E can be crashed only to that extent.
Hence crash the activity E by 3 days. Now path BEF and CF are both equally critical. Project duration is now 17 days.

Step 3 - Any reduction in activity time on one path now has to be matched by equal reduction on second path to have any impact on project duration. So, check the cost of crashing activities in such a manner that there is equal reduction in time on both critical paths. The option available are:
- Reduce F (common activity for both paths) Rs 40,000
- Reduce C & B simultaneously = 25,000 + 30,000 = Rs 55,000
- Reduce C & E simultaneously = 30,000 + 15,000 = Rs 45,000
Choose the lowest, i.e. F and reduce by one day. Project duration is now 16 days.

Step 4 - Keep tracking the reduction in no. of days.
Here E is already reduced by 3 days and can be crashed by one more day. F has been crashed by one day and no further crashing is possible.

Step 5 - Repeat Step 3. Options available are:
- Reduce C & B simultaneously = 25,000 + 30,000 = Rs 55,000
- Reduce C & E simultaneously = 30,000 + 15,000 = Rs 45,000
Choose the lowest, i.e. C&E and reduce by one day. Project duration is 15 days now and all paths have become critical now. Any further reduction has be simultaneous on all three paths.

Step 6 - Options available are:
- Reduce A + C + B simultaneously = 30000 + 30000 + 25000 = 85,000/-
- Reduce D + C + B simultaneously = 10000 + 30000 + 25000 = 65,000/-
Choose the lowest, in this case it is 65,000/-. But cost of crashing Rs 65,000 > 60,000, the saving of indirect cost. Therefore, there is no point crashing the project time below 15 days.

If Crash cost is not given directly: Crash cost/day = \(\frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Duration} - \text{Crash Duration}}\)

**Activity on Node (AON)/Precedence Diagramming Method (PDM)**

1. Each node in the network diagram represents an activity. (Usually drawn as a rectangular box)
2. An arrow is drawn between two activities indicating their logical interrelationship.
3. Network may start in multiple nodes as starting activities and also end in multiple nodes as finishing activities.
4. Description of activity is usually written within the space available in rectangular box.

5. Such diagrams eliminate the need for showing of dummy activities.

6. It is also possible to represent different types of relationships between activities with their Lead–Lag time restraints such as

   (a) Finish–Start (FS),
   (b) Start–Start (SS),
   (c) Finish–Finish (FF) &
   (d) Start–Finish (SF)

The project management computer packages mainly use Activity on Node convention.

**Q. Advantages of "Precedence Diagramming" alias AON networks.**

**Ans.** AON networks is the preferred method as it can represent complex activity relationships or dependencies such as Start–Start, Finish–Finish, etc, apart from the normal Finish–Start relationship possible in case of AOA method. In addition, there are several other benefits of this method –

   (a) It can represent Lead & Lag times for dependant activities.
   (b) AON representation eliminates necessity for ‘Dummy’ activities to maintain the logic.
   (c) AON networks are comparatively simpler to draw and more useful for activity oriented networks.
   (d) Network calculations are possible in ‘Multiple Start’ & ‘Multiple Finish’ networks.

**Legend**

- represent “Activity”
- represent “Relationship”

<table>
<thead>
<tr>
<th>Activity</th>
<th>Float Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>LST</td>
<td>LFT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EST (FF)</th>
<th>EFT</th>
</tr>
</thead>
</table>

Layout of a Node
Example: 2002 – 7(b)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Predecessor</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>A</td>
<td>7</td>
</tr>
<tr>
<td>E</td>
<td>B</td>
<td>6</td>
</tr>
<tr>
<td>F</td>
<td>B</td>
<td>8</td>
</tr>
<tr>
<td>G</td>
<td>C, E</td>
<td>10</td>
</tr>
<tr>
<td>H</td>
<td>D, F</td>
<td>4</td>
</tr>
</tbody>
</table>

Step – 1: To find ES and EF
Starting activity A
A - ES = 0, EF = 0 + 6 = 6
C – ES = 6, EF = 6 + 5 = 11
D – ES = 6, EF = 6 + 7 = 13

Step – 2: Start activity B
B – ES = 0, EF = 0 + 4 = 4
E – ES = 4, EF = 4 + 6 = 10
F – ES = 4, EF = 4 + 8 = 12
Step – 3 : G – ES = 11 (because the earliest the activity G can start is only on 11, since EF of C is 11 and EF of E is 10 and in forward pass we take the highest value)
EF = 11 + 10 = 21

Step – 4 : H – ES = 13 (because the earliest the activity H can start is only on 13, since EF of D is 13 and EF of F is 12 and in forward pass we take the highest value)
EF = 13 + 9 = 22

In this the project duration is 22, we have to take the maximum of the two.

To find the LF and LS we should start in the reverse order, hence

Step –5 : G – LF = 22 as it is the maximum duration
LS = 22 –10 = 12
E – LF = 12, LS = 12 – 6 = 6
C – LF = 12, LS = 12 – 5 = 7

Step – 6 : H – LF = 22, LS = 22 – 9 = 13
F – LF = 13, LS = 13 – 8 = 5
D – LF = 13, LS = 13 – 7 = 6

Step – 7 : A – LF = 6 (because the latest the activity A can finish is on 6, since LF of D is 6 and LF of C is 7 and in backward pass we take the lowest value)
LS = 6 – 6 = 0

Step – 8 : B – LF = 5 (because the latest the activity B can finish is on 5, since LF of E is 6 and LF of F is 5 and in backward pass we take the lowest value)

Now find the Total Float :

Step – 9 : A = ES – LS or EF – LF
= 0 – 0 or 6 – 6
= 0

Similarly find for all the activities

Now find the Free Float :

Step- 10 : G = 22 – 21 = 1
C = 11 – 11 = 0
A = 6 – 6 = 0
E = 11 – 12 = 1

Step – 11 : H = 22 – 22 = 0
D = 13 – 13 = 0
F = 13 – 12 = 1
B = 4 – 4 = 0

Therefore the critical path is A – D – H

\[ A \rightarrow D \rightarrow H \]

**Example – 2000 – 7(b)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
<th>Predecessor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digging trench</td>
<td>15 days</td>
<td>-</td>
</tr>
<tr>
<td>Laying Cable</td>
<td>12 days</td>
<td>1</td>
</tr>
<tr>
<td>Re-filling</td>
<td>15 days</td>
<td>2</td>
</tr>
<tr>
<td>Total Duration</td>
<td>42 days</td>
<td></td>
</tr>
</tbody>
</table>

Here the relationships are not properly defined. In the normal course we start activity 2 after activity 1 finishes. But, logically speaking, activity 2, i.e. laying of cable need not wait till such time activity 1, i.e. digging trench, is completed. After initial part of the trench is
dug, cable laying can start in that portion while trench is being dug further. The two activities can move in tandem thereafter. Therefore, we need to correct out relationships and properly define them.

Following are some of the relationships which are possible:

1. **Start – Start (SS)** – Start of predecessor determines start of successor. But we still do not know what is the time gap between start of two activities. Generally, it depends on the normal work practice.

   ![SS relationship diagram]

   

2. **Finish – Start (FS)** – Finish of predecessor determines start of successor. FS + 24 hrs: ‘+’ indicates lag between Finish & Start. Successor activity can start only 24 after completion of predecessor activity. Similarly FS – 2 days: ‘–’ indicates lead between Finish & Start. Successor activity can start 2 days before completion of predecessor activity.

3. **Finish – Finish (FF)** – Finish of predecessor determines finish of successor

4. **Start – Finish (SF)** – start of predecessor determines finish of successor

   Example: :- delaying of purchases till the last moment.

### Example :- 1998 – 6(b)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
<th>Predecessor</th>
<th>Relationship</th>
<th>Lead / Lag</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>-</td>
<td>FS</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>A</td>
<td>FS</td>
<td>- 2</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>A</td>
<td>FS</td>
<td>+ 3</td>
</tr>
<tr>
<td>D</td>
<td>7</td>
<td>C</td>
<td>SS</td>
<td>-</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>C</td>
<td>FF</td>
<td>+ 4</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>B</td>
<td>FS</td>
<td>-</td>
</tr>
<tr>
<td>G</td>
<td>2</td>
<td>E</td>
<td>FS</td>
<td>-</td>
</tr>
<tr>
<td>H</td>
<td>6</td>
<td>G</td>
<td>FS</td>
<td>- 2</td>
</tr>
<tr>
<td>I</td>
<td>3</td>
<td>G</td>
<td>FS</td>
<td>-</td>
</tr>
<tr>
<td>J</td>
<td>4</td>
<td>H</td>
<td>SS</td>
<td>+ 4</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>J</td>
<td>FF</td>
<td>+ 1</td>
</tr>
</tbody>
</table>
To find ES and EF

Step – 1 : A – ES = 0, EF = 0 + 5 = 5
   B – ES = 5 – 2 = 3 (because the relationship is FS – 2 )
   EF = 3 + 3 = 6
   C – ES = 5 + 3 = 8 (because the relationship is FS + 3)
   EF = 8 + 4 = 12
   D – ES = 8 (because the relationship is SS)
   EF = 8 + 7 = 15
   To find the ES and EF of E first find EF of ‘E’ because the relationship is FF
   E – EF = 12 + 4 = 16
   ES = 16 – 5 = 11 (i.e. EF –Duration of ‘E’)
   G – ES = 16 (because the relationship is FS)
   EF = 16 + 2 = 18
   I – ES = 18 (because the relationship is FS)
   EF = 18 + 3 = 21

Step – 2 : F – ES = 14 (the relationship is FS – 1 between D & F, .: ES of F would be 15 – 1 = 14 and 6, since EF of ‘B’ is 6.
   In this case it is 14. .: \textbf{ES of F is 14})
   EF = 14 + 3 = 17
   H – ES = 17 (the relationship is FS between F & H, hence we get ES of H as 17 and 16, because the relationship between G & H is FS – 2, .: 18 – 2 = 16 and in forward pass we consider the higher value, .: \textbf{ES of H is 17})
   EF = 17 + 6 = 23
   J – ES = 21 (the relationship is SS + 4 between H & J, .: ES of ‘J’ = EF of ‘H’ + duration = 17 + 4 = 21)

Step – 3 : K – ES = 24 (the relationship is FF + 1 between J & K, .: ES of ‘K’ = 25 – 1 + 2
= 24 and  
ES = 21 because relationship is FS between I & K In forward pass we consider the Higher value, ∴ ES of K is 24)

To find LS and LF

Step – 4 : K – LF = 26 (since we are finding the LF)  
LS = 26 – 2 = 24  
J – LF = 24 + 1 = 25 (since the relationship is FF + 1)  
LS = 25 – 4 = 21  
H – LF = 23 (the relationship is SS + 4 between J & H, ∴ we first find LS of H which is LF of ‘J’ – Duration of ‘J’ = 21 – 4 = 17)  
LS = 17  
I – LF = 24 (because the relationship is FS)  
LS = 24 – 3 = 21

Step – 5 : G – LF = 19 (the relationship between H & G is FS – 2, ∴ LS = 17 + 2 = 19 and LS = 21 because of relationship between I & G. In backward pass we consider the lower value, in this case it is 19)  
LS = 19 – 2 = 17  
E – LF = 17 (because the relationship is FS)  
LS = 17 – 5 = 12

Step – 6 : F – LF = 17 (because the relationship is FS between H & F)  
LS = 17 – 3 = 14  
D – LF = 14 + 1 = 15 (because the relationship is FS – 1 and in backward pass we add)  
LS = 15 – 7 = 8  
B – LF = 14 (because the relationship is FS)  
LS = 14 – 3 = 11

Step – 7 : C – LF : to find LF first find LS since the relationships are SS and FF.  
While considering the relationship between D & C we get LS = 8, ∴ LF = 8 + 4 = 12 and  
While considering the relationship between E & C which is FF + 4, we get  
Now since 12 is the least, we consider it as the LF of C)  
LF = 12 and LS = 8

Step – 8 : A – LF = 5 (in this case also we get two LF’s because of relationship between B & A and  
Between C & A which is 5 & 13. Since 5 is the least we consider it as our LF)  
LS = 5 – 5 = 0
Use of CPM in Optimisation of Project Cost.

Total project cost comprises of the ‘direct cost’ for performing activities (material, labour & machinery costs, equipment hire costs, etc) and ‘indirect cost’ (overheads, supervision, interest, down time cost, loss of revenue etc). It is observed that while the indirect costs are directly proportional to the project duration, the direct costs are inversely proportional to activity duration (average time). This means that the indirect costs reduce with the project duration while an extra expenditure has to be incurred on activities to reduce their duration. In order to optimise the project cost it is necessary to find a balance between the cost savings due to reduction in indirect costs and additional direct costs due to reduction of activity duration.

The project cost optimisation process by use of CPM (Critical Path Method) is a two step process. The first step involves finding the minimum time required to complete the project under normal circumstances by identifying the critical path which is the longest path among all the paths. Once this path is identified, additional cost of crashing various activities viz a viz savings in indirect cost is examined. This trade off between direct costs and indirect costs is done till cost of crashing begins to exceed the gains in indirect costs. This cost is then the optimum cost of the project.

In real life situations, it is difficult to obtain accurate cost – time relationship data (cost of activity crashing Vs gains on Indirect costs) on various activities either because data are not available or because estimates are too bothersome and expensive to compile. But even if the accurate data are not available, best guesses, unless completely arbitrary, are useful information and help project manager to arrive at better decisions.
Three Time Estimate method for Network Scheduling

Estimation of time required for completion of various activities in the project is one of the crucial issues in network scheduling. Normally, estimates are done by project personnel based on data of similar activities in the past. However, in case of some projects, like, research and development projects, for which PERT method is used, there is no past data to base the time estimates. Sometimes, external factors have strong influence on the project and therefore, the time required to complete the project is not precisely known. Time estimation in such cases is done through statistical method called “Three Time Estimates”.

Time estimation by this method is essentially a weighted average of three time estimates, viz, Pessimistic time estimate, Optimistic time estimate and Most likely time.

(a) **Pessimistic Time Estimate** – Considering that activity faces maximum possible problems & delays.

(b) **Optimistic Time Estimate** – Considering that activity does not encounter any problems.

(c) **Most Likely Time** – Considering the activity faces moderate delays as normally expected.

**Average time** for the activity to be used for network calculation is given by formula

\[
\text{Average time} = \frac{\text{Pessimistic time} + (4 \times \text{Most likely time}) + \text{Optimistic time}}{6}
\]

The probability of the project completing within the total schedule time calculated on the basis of three time estimates is 50 %

The problem is solved using the following steps:

(a) Using the formula, the average time for various activities is calculated.

(b) Network is drawn based of relationships given in the table.

(c) Critical path is identified as the longest path in the network out of various paths available. (This avoids time consuming computation of Early / Late start & finish times)

(d) Find standard deviation for critical activities

\[
\sigma = \frac{\text{Pessimistic time} - \text{Optimistic time}}{6}
\]

(e) Find variance \( \sigma^2 \) for critical activities.

(f) Find standard deviation of critical path durations = \( [\sum \sigma^2]^{\frac{1}{2}} \)
(g) Adding one standard deviation duration to the critical path duration gives the duration for completion with 84.1% probability.

**Example** - Following table illustrates the calculations. Shaded activities are critical activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>T Optimistic</th>
<th>T Most likely</th>
<th>T Pessimistic</th>
<th>T Average</th>
<th>SD</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 2</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>7</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>1 – 6</td>
<td>2</td>
<td>5</td>
<td>14</td>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2 – 3</td>
<td>6</td>
<td>12</td>
<td>30</td>
<td>14</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>2 – 4</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3 – 5</td>
<td>5</td>
<td>11</td>
<td>17</td>
<td>11</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4 – 5</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>7</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>6 – 7</td>
<td>3</td>
<td>9</td>
<td>27</td>
<td>11</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5 – 8</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7 – 8</td>
<td>4</td>
<td>9</td>
<td>28</td>
<td>18</td>
<td>4</td>
<td>16</td>
</tr>
</tbody>
</table>

Sum of variances of critical activities = 25
Square root of the sum of variances = 5

Critical path duration + 1 Standard deviation = 36 + 5 = 41 days
Hence 41 days duration has probability of 84.1%.

✓ **Central Limit Theorem** - When different distributions are added then the result is a normal distribution.
The chance of completing the activity in average time, i.e. $t_a$ is 50%.

$$t_a = \frac{t_p + 4t_m + t_o}{6}$$

**Example : 1999 – 6(b)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>$t_o$</th>
<th>$t_m$</th>
<th>$t_p$</th>
<th>$t_a$</th>
<th>Variance = $(t_p - t_a/6)^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>1 - 6</td>
<td>2</td>
<td>5</td>
<td>14</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2 - 3</td>
<td>6</td>
<td>12</td>
<td>30</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>2 - 4</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3 - 5</td>
<td>5</td>
<td>11</td>
<td>17</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>4 - 5</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>6 - 7</td>
<td>3</td>
<td>9</td>
<td>27</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5 - 8</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>7 - 8</td>
<td>4</td>
<td>19</td>
<td>28</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

P₁ = 1 – 2 – 3 – 5 – 8 = 36 :- chance of completing in 36 days is 50 %
\[ P_2 = 1 - 2 - 4 - 5 - 8 = 23 \]
\[ P_3 = 1 - 6 - 7 - 8 = 35 \]

\[ \text{Tchebychev's Theorem} \] - It states that for various statistical observations the overall range is covered in 6 standard deviations.

\[ \therefore \sigma = \sqrt{\Sigma \text{variance}} \]
\[ = \sqrt{25} \]
\[ = 5 \]

\[ +1 \sigma = 84.1 \% \quad -1 \sigma = 15.9 \% \]
\[ +2 \sigma = 97.3 \% \quad -2 \sigma = 2.7 \% \]

i.e. chance of completing project in 41 days is 84.1% where it is \(36 + 1\sigma\) and so on.

\[ Z = \frac{\text{Desired Duration} - \text{Mean Deviation}}{\sigma} \]

\[ Z = \frac{40 - 36}{5} = 0.8 \]

**Q. How are floats or slacks used in effective management of projects? How do terms ‘Total Float’ and ‘Free Float’ differ in their significance? When can project schedule calculations show ‘Negative’ floats?**

**Ans.** The floats available on non-critical activities indicate the flexibility in scheduling the activities and also the maximum extent to which the activity completion can be delayed without affecting the project completion date.

Total float signifies the maximum permissible delay without delaying the final completion while Free float signifies the maximum permissible delay without delaying the earliest start of its immediate successor activity.

Knowing the available floats on various activities helps the project manager to plan and organise day-to-day activities in the face of resource constraints, and concentrate efforts and resources on critical activities.

Negative float indicates that the time available is less than the time required to perform the activity and unless the activity duration is compressed or ‘crashed’ to the extent of negative float, the scheduled completion date can not be met.
Resource Levelling / Smoothening

Q How do the resource constraints affect the project schedules? What is resource levelling/smoothening? Discuss various problems encountered in resource allocation to activities under a situation of multiple resource requirements with limited availability and what are the different alternatives to allocate resources without affecting the final completion date?

Ans. Pert and CPM method of project scheduling assume unlimited availability of resources which is almost never the case. All activities are planned to start at their earliest times without any consideration to resource constraints for performing the activities. Such schedule invariably gives rise to a situation where requirements of various resources on day-to-day basis show very large variations. Such situation is not desirable as uneven loading of costly resources leads to situation where either the resources are not available or, when available, they are under utilised and adds to cost of the projects in terms of hiring/depreciation/finance cost of those resources.

It is therefore necessary to smoothen out the peak requirements and contain the maximum resource requirement within reasonable level. This is known as resource levelling and smoothening and is achieved by adjusting the schedules of non-critical activities within the available floats.

In the schedule arrived at with PERT/CPM model, Critical Path activities, where no float/slack is available take precedence in execution. In order to ensure that final date is maintained, it is utmost essential that critical path activities are not delayed. Thus, Critical Path Activities have the first claim on resources. Residual resources can then be allocated to Non-Critical Path Activities. Non critical path activities in that case may have to be rescheduled. The fear then is that a non critical path activity may become critical. The different alternatives to overcome resource constraints and to avoid delay in the final completion date are various empirical methods trying to find optimum allocation within flexibility of the network. The main methods used are –

(a) Postponing or Shifting of non critical activities within available activity floats. Start of Non critical path activities is delayed till availability of resources.

(b) Stretching the activity durations within the float with reduction in resource allocation. In this case, partial allocation of resources is made for non critical activities by allocating left over resources (after meeting the requirement of critical activities).

(c) Splitting of non critical activities in parts when technically feasible. The
activity is split into parts and each part is performed separately when ever resources are non needed by critical activities.

Despite application of above measures, the project may still not be feasible to be completed within schedule. In such a situation, trade off is done between cost and time by crashing the activities where resources are aplenty.

This exercise is very complicated. Complexities increase as more variety of resources are considered. Heuristic algorithms (Rules of Thumb, trial and error method) are developed to perform this exercise with help of computer programs.

Q. Why is the accuracy of estimation of time duration of individual activities is important in Critical Path Analysis? Explain the methods and tools used for time & Resource estimation.

Ans. The Critical Path Analysis focuses on completing the project at the earliest possible time and if possible at minimum cost. Accurate time estimation is essential to good project management. It is important to get time estimates right for two main reasons–

(a) Time estimates drive the setting of deadlines for delivery of projects, and hence clients' assessments of your reliability

(b) They often determine the pricing of contracts and hence their profitability.

CPM is used for the projects in which the organization has previous experience or has access to historical information about the activities. As a first step, it is essential to understand the correct scope of work estimate (the total work content of the activity). CTR Charts (Cost– Time– Resource Charts) that are available for different trades such as civil construction, structural fabrication, etc. further help in preparation of estimates of time, resource requirements and costs quite accurately. The CTR catalogue defines the scope of each activity in the network along with its estimated cost, resources required, and the time for completion. The network then read in conjunction with CTR catalogue becomes the basis for measuring progress; valuing the work done, cost reporting, forecasting and overall control of the project.

Bar Chart –

Popularly known as Gantt chart after the name of En Henry Gantt who popularised it. You need for this:

(a) List of activities

(b) Estimated time of completion of individual activity
**Negatives of Bar Chart**

(a) It doesn’t clearly show the relationship/dependencies between the activities and hence it can be understood only by the person who has drawn it. Thus, if an activity gets delayed then the impact it will have on other activities cannot be assessed by everyone.

(b) It is not useful for complex projects. If a project involves 100 activities then the bar chart will require 15 pages and inter relationship of an activity on page 3 will be difficult to understand with the activity on page 13.


**RISK MANAGEMENT**

Risks are inherent part of any activity/process/business. Knowing the risks and providing for them gives a true picture of business potential. Any project assessment without discounting the risks is futile. Risk has two components;

(a) Probability of occurrence, and

(b) Impact/severity

While impact/severity is constant, probability increases with duration of event.

**Risk Management Process**

Risk Management is a three step process.

**Step – 1 : Identify Risks**

All possible risks, external (natural calamity, financial, political, social, legal, etc) as well as internal (planning errors, execution errors, men, material, processes, fraud, etc) which may affect the project, are identified. A list of such risks is prepared, then categorized. Eg. Risk of increase in interest rates, risk arising out of recall of borrowed funds, Risk of govt lowering the import duties on similar products, etc.

There are several methods to assess the risk, one of them is fish bone diagram.

**Step – 2 : Assess Their Probability and Severity.**

Evaluate the risks in terms of the probability of their occurrence and then their impact on your business. Their product is the net risk. For example – one may have assumed a particular interest rate but the economic and fiscal conditions of the country may be hinting at strong possibility of interest rates shooting up. So, probability is high. Again, its impact is to be assessed. If the product has low profit margins and you are planning high leverage, minor changes in interest rates will also impact the profitability severely. Thus, this risk is very high.

The effects can be assessed like High / Low / Moderate, such kind of approach is qualitative approach.

**Step – 3 : Decide the Response**

Once the potential risks and their impact have been assessed, you need to manage them. There are various responses available to the risk and can be categorized as :

- **Avoid – Red Zone**
• Reduce
• Transfer
• Accept
• Contingency provision

The response will depend on how the risk has been categorized i.e. High / Low / Moderate

**Red Zone** – Situations where both or at least one of the factors (Probability and Impact) is High and the other is not below Medium are rated as Red Zone. Such risks are best avoided. Choose another option.

**Green Zone** – Situations where both or at least one of the factors is low and the other factor is not more than Medium, are rated as Green Zone. Such risks should be accepted because one is aware that even if the risk does materialize, the impact can be borne by the company without getting completely crippled. A small contingency provision is made against such risks.

**White Zone** – Situations where at least one risk is High and the other low or both are Medium do not allow a rule of thumb response. Such situations are tricky and call for a well deliberated response.

**Risk Analysis**

1. **Sensitivity Analysis** – Sensitivity analysis is assessment of severity of impact due to adverse changes in various factors. Suppose, you have done your project feasibility study on Sale Price of Rs 100 and volume of 1,000,000 pieces. Now, you ought to assess the scenario of not being able to achieve the expected volume at SP of Rs 100. In such a case, you will have to either reduce the price or contend with lower sales volume. You find the impact of each rupee of reduction in sale price on project’s profitability keeping volume constant. Then you find the impact of reduction in volume keeping price constant. Suppose it is a low fixed cost product,
it will be less sensitive to volume drop but highly sensitive to price drop. Vice versa, if the project is high fixed cost project, it will be highly sensitive to volume drop because high fixed cost will get distributed over lower number of pieces increasing their effective cost. In financial parlance, products with high fixed cost have higher contribution which is lost due to lost sales.

2. **Scenario Analysis** – Scenario Analysis is one of the methods of risk analysis to evaluate the effect of changes in project assumptions on its profitability. The normal scenario is the combination of factors (variables) on which project feasibility is worked upon. In simple sensitivity analysis, typically one variable is varied at a time to observe its effect on the project profitability. However, if the variables are inter related, it is advisable to analyse certain plausible combinations of variables rather than single variable at a time.

The primary factors that affect the project profitability are generally the sales price, sales volumes, material costs, labour costs, project costs etc. Concurrent changes in these factors within the possible range will give rise to many plausible combinations. There can be hundreds of combinations and it would be unwieldy to analyse each combination. Therefore, generally only three combinations, categorised as optimistic, normal and pessimistic scenarios are built up and their effects studied. Further, attaching probability estimates to each of the three scenarios, overall evaluation can be carried out.

3. **Simulative Analysis** – Instead of visualizing the scenario, you carry out simulation exercise. One of the technique to simulate the exercise is using Monte Carlo technique. There are standard packages available for simulation, in these 10,000 observations are possible of various combinations. When a graph is plotted of various combination then the outcome is a normal distribution curve.

**Use of Risk Analysis for Project Evaluation and Appraisal**

Project evaluation and appraisal is done on the basis of forecasts of lot of factors which can not be accurately quantified, like sales prices and volume, cost of capital assets and inputs, taxation rates, foreign exchange rates. These forecasts and estimates may turn out to be at significant variance from reality. Large deviations may adversely affect the project feasibility.

There are various statistical and other techniques for assessing risks, their probabilities and effects. Sensitivity analysis, scenario analysis, Monte-Carlo simulation methods, etc, evaluate effects of variability of various factors either singularly or jointly. Subjective probabilities are further attached to evaluate the project under optimistic, pessimistic and most likely situations out of various possible outcomes before a final decision is made.

In absence of extensive analysis, project feasibility is worked out on the basis of conservative estimates for project revenues and adequate safety margins in cost provisions.
Q. What are the types of Project Risks? What measures of risk are used to assess the risk factor in project management?

Ans. The three types of project risks are—

• **Stand Alone Risk** – The risk when the project is viewed in isolation
• **Firm Risk or Corporate Risk** – This represents contribution to the risks of the firm by the project.
• **Systematic Risk or Market Risk** – This represents the riskiness of project in the context of market portfolio.

**Measures of risk** –

• Range
• Mean Absolute Deviation
• Standard Deviation
• Coefficient of Variation
• Semi Variance

The Standard Deviation is the most commonly used measure of risk in finance because it is analytically easily tractable. Also, if the probabilities are normally distributed, the mean and standard distribution give all information about the same.

Q. Why is ‘Risk Analysis’ considered as an integral part of project evaluation? Name any three methods of incorporating risk factor in project evaluation and explain the procedure steps for any one of them.

Ans. The cost and benefit forecasts of project are based on various assumptions relating to various parameters such as sales quantity and prices, material prices, labour costs and their output levels, project life, etc. Accuracy of prediction of these parameters is affected by knowledge of personnel involved as well as unfolding of external macro environment, like govt policies, which are beyond our control. This uncertainty about the future gives rise to the risk of making project unviable. While some of these risks can be reduced, some can be provided for and some can be avoided by using alternative options. Therefore, it is necessary to analyse the risks involved and their impact on the project.

Three commonly used methods for incorporating risk factor in project evaluation are—

(a) Sensitivity analysis
(b) Scenario analysis
(c) Monte Carlo Simulation analysis
Steps involved in Sensitivity Analysis—

(a) Set up relationship between basic underlying factors i.e. sales quantity, unit price, material & labour costs, project life etc. and the Net Present Value or IRR.

(b) Estimate range of variation and most likely value for each of the basic underlying factors

(c) Study the effect of variations in the basic variables on NPV or IRR; with one factor taken at a time.

Steps involved in Scenario Analysis—

(a) Since many variable factors are interrelated, plausible scenarios with a combination of changes in variables are worked out.

(b) Effect on NPV or IRR is found under different scenarios. Typically; optimistic, pessimistic and base case scenarios are evaluated.

Steps involved in Monte Carlo Simulation—

One type of spreadsheet simulation is Monte Carlo simulation, which randomly generates values for uncertain variables over and over to simulate a model.

Risk Register

The Risk Register records details of all the risks identified at the beginning and during the life of the project, their grading in terms of likelihood of occurrence and seriousness/impact on the project, initial plans for mitigating each high level risk and subsequent results.

It usually includes—

(a) A unique identifier for each risk;

(b) A description of each risk and how it will affect the project;

(c) An assessment of the likelihood of its occurrence and the possible seriousness/impact if it does occur (low, medium, high);

(d) A grading of each risk according to a risk assessment table;

(e) Who is responsible for managing the risk;

(f) An outline of proposed mitigation actions (preventative and contingency); and
(g) In larger projects, costing for each mitigation strategy.

This Register should be maintained throughout the project and will change regularly as existing risks are re-graded in the light of the effectiveness of the mitigation strategy, and new risks are identified. In smaller projects, the *Risk Register* is often used as the Risk Management Plan.
**DECISION TREE**

The name decision tree emanates from the structure of the figure. Out of each decision or chance, there are more decisions and chances emanating. Thus, the branching takes place and eventual structure looks like a tree.

In a decision tree there are two kinds of nodes; Decision Points where you will take a deliberate decision and control next set of events. Such node is represented by a rectangle and Chance Points where events occur based on probability and you have no control over their occurrence. These nodes are represented in the diagram by circles.

- Decision Point
- Chance Point

**Application of Decision tree analysis**

Decision Tree analysis is found useful in analysing situation where there is sequential decision making. A situation, where each alternative leads to a further bunch of alternatives and there are two or more steps of such branching. Obviously, each alternatives, sub-alternative and sub-sub-alternative will have a probable success rate.

**Basic steps involved in the analysis are –**

1. Identify the problem and the alternatives available.
2. Form the decision tree (technically called – Delineating the decision tree). Draw Decision points (square nodes), chance points (circular nodes) alternatives available for action (on lines).
3. Specify probabilities & monetary values for various outcomes.
4. Evaluate the alternatives. -Evaluate monetary values of chance points and

**Decision Tree Notations**

- Don’t Invest
- Invest
- Succeed
- Fail

0.7
0.3
decision points in a backward manner till reaching the original decision point.

Example : 2000 – 5(b)

A company has an investible surplus of Rs. 100 crores. Investing this amount in its existing business can give a certain return of 8%. Alternatively, there is an opportunity for diversification which, if successful, is estimated to bring a return of 17%. However if diversification is not successful, expected return will be only 2%. What must be the probabilities for two outcomes of diversification in order to make the diversification worthwhile?

Ans.

Diagram Evaluation:

Step 1 – Start from right to left

Step 2 – Suppose chance of success is S, then chance of failure is \( (1 – S) \)
Therefore, evaluation of \( C_1 \) is
\[
S \times 17\% + (1 - S) \times 2\%
\]

Step 3 – Since the old business gives maximum of 8 %, \( \therefore \) going with the new route should give at least 8% output.
\[
\therefore 17S + (1 - S) \times 2 = 8
\]
\[
17S + 2 - 2S = 8
\]
\[
15S = 6
\]
\[
S = 0.4
\]
i. e. 40% chance of success is the minimum requirement.

Example : 2002 – 4 (b)

Motor City Auto Co. must decide whether or not to introduce a new car, which features a radically new pollution control system. They must also decide whether or not to first see if results of test marketing of a limited production show promise or not. The test marketing of
limited production will cost Rs. 4.0 crores. The marketing department has estimated that:
- If the new car achieve high acceptance by the public, company profits will be increased by Rs. 25 crores.
- Low acceptance by public will reduce company profits by Rs. 15 crores.
- Not introducing the car will of course, not affect profits.

Probabilities for different outcomes through alternate actions are estimated as under:
- If test marketing is not done, the possibility for high acceptance is judged to be 0.40.
- The assumed probability for a favorable result from test marketing is 0.50.
- The conditional probability for high acceptance after a favorable result is 0.64.
- If car is introduced in spite of unfavorable test marketing results, probability for low acceptance after is 0.84.

Construct the decision tree and determine the optimal course of action.

```
Step 1: Start evaluating from right
i.e. start from C2
It is given that the probability for high acceptance after a favorable result = 0.64.
Therefore, the probability for low acceptance after a favorable result is (1 - 0.64) = 0.36
```
\[ C_2 = 25 \times 0.64 + (-15) \times 0.36 = +10.6 \]

**Step 2:** Since the value of Decision \( D_2 \) is Higher of chance \( C_2 \) and “Not to introduce”

Value of \( D_2 = +10.6 \)

**Step 3:** Now going to chance \( C_3 \)

It is given that if the car is introduced in spite of unfavorable test marketing results, the probability for low acceptance = 0.64.

Therefore, the probability for high acceptance after a unfavorable test result

\[ = (1 - 0.84) = 0.16 \]

\[ \therefore C_3 = 25 \times 0.16 + (-15) \times 0.84 = -8.6 \]

**Step 4:** Since the value of \( C_3 \) is negative we decide not to introduce the car. Therefore, value of \( D_3 = 0 \).

**Step 5:** To find the value of chance \( C_1 \)

Since the assumed probability for a favorable result from test marketing is 0.5 i.e 50%, therefore we consider 50% of value of each of \( D_2 \) & \( D_3 \).

\[ \therefore C_1 = 50\% \text{ of } D_2 + 50\% \text{ of } D_3 \]

\[ \therefore C_1 = 5.3 \]

**Step 6:** Now find the value of Chance \( C_4 \)

It is given that if test marketing is not done, the possibility of high acceptance is judged to be 0.4

\[ \therefore \text{the probability of low acceptance if test marketing is not done is } (1 - 0.4) = 0.6 \]

\[ C_4 = 25 \times 0.4 + (-15) \times 0.4 = 1 \]

**Step 7:** Since the value of chance \( C_4 \) is greater than the value when the product is not introduced, the value of \( D_4 = 1 \)

**Step 8:** Now, when the test marketing is done, net value of \( D_1 = 5.3 - 4.0 = 1.3 \) and

And when test marketing is not done, the value of \( D_1 = 1 \)

Since the value when test marketing is done is higher, it is the optimum course of action.
SCHEDULING WITH RESOURCES

**Process** - Steps involved are:

1. **Resource Estimation** – Estimate resources required to accomplish individual tasks.
2. **Resource Loading** – Excess resources to be organized from time to time.
3. **Resource Levelling** – Reschedule tasks to minimize period to period variation in resources without affecting completion date.
4. **Resource Allocation** – Reschedule tasks to remain within resource constraints with or without project delay.

**Example**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
<th>Predecessor</th>
<th>Successor</th>
<th>Manpower resource allocation</th>
<th>Slack</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>-</td>
<td>1</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>-</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>-</td>
<td>7</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>-</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>G</td>
<td>3</td>
<td>5, 7</td>
<td>9</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>H</td>
<td>4</td>
<td>8, 6</td>
<td>-</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>D7</th>
<th>D8</th>
<th>D9</th>
<th>D10</th>
<th>D11</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Levelling is done for non – critical activities by:
  - Shifting
  - Stretching
  - Splitting
Logic

- Start with day 1 of project
  - Set D = 1
  - Select list of jobs that can begin on day “D”
    - Sort jobs in increasing order of their slack
      - Set x = 1
      - Are sufficient resources available to schedule job x in list?
        - Yes
          - Schedule job x. reduce resources remaining
          - Have all jobs in list for day “D” been considered?
            - No
              - Go on for next job on list. Increase x by 1
            - Yes
              - Are there any jobs remaining to be scheduled?
                - Yes
                  - Go on to next day. Increase D by 1
                - No
                  - Stop. Schedule is complete
        - No
          - Is job x critical?
            - No
              - Postpone job x until next day
            - Yes
              - Can resources be obtained from non critical jobs already scheduled?
                - No
                  - Schedule job x. Make adjustments in other jobs affected. Reduce resources remaining
                - Yes
                  - Go on to next job on list. Increase x by 1
Comparative advantages and utilities of Gantt Chants.

- Simple, easy to construct
- Clear start and finish times on a clear time scale
- Good for displaying milestones
- And comparing actual progress with planned
- Good for grouping similar activities
- Easy to indicate WBS reference numbers
- Very good for small projects

Example: 1999 – 7(b)

Draw a ‘Gantt Chart’ and ‘Resource Graph’ for the project schedule based on the table below and find out the following:

1. Total time for completion
2. Days of over allocation of resources if maximum workers available are 20.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Immediate Predecessors</th>
<th>Duration</th>
<th>Allocated Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>B</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>B</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>F</td>
<td>B</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>G</td>
<td>C, D</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>H</td>
<td>E</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>I</td>
<td>F</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>J</td>
<td>G, H, I</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Activity</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>----------</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>E</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>F</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>G</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>I</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>J</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Page 77 of 107 - Project Management (Ver1.1 - 09/03/2007)
Jamnalal Bajaj Institute of Mgmt Studies*
**PROJECT FINANCE**

**Q.** What are the main constituents of the project cost and their basic elements to be considered for preparing project feasibility report.

**Ans.** The main constituents of the ‘Project Cost’ and their basic elements to be considered for preparing project report are –

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Land</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land Cost/Lease premium, conveyance deed charges</td>
</tr>
<tr>
<td></td>
<td>Land levelling &amp; development</td>
</tr>
<tr>
<td></td>
<td>Approach roads, internal roads</td>
</tr>
<tr>
<td></td>
<td>Fencing, gates, tubewells etc.</td>
</tr>
<tr>
<td><strong>2. Buildings</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Main Buildings for plant &amp; equipment</td>
</tr>
<tr>
<td></td>
<td>Utility buildings such as boiler house, pump house, labs, warehouses, electrical distribution etc.</td>
</tr>
<tr>
<td></td>
<td>Other non-factory buildings – Admin, canteen, etc</td>
</tr>
<tr>
<td><strong>3. Plant &amp; Machinery</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Imported machinery</td>
</tr>
<tr>
<td></td>
<td>Indigenous machinery</td>
</tr>
<tr>
<td></td>
<td>Cost of machinery to include all costs landed at site, spares, foundation &amp; installation.</td>
</tr>
<tr>
<td><strong>4. Technical know– how</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Foreign Collaborators fees</td>
</tr>
<tr>
<td></td>
<td>Technical consultant fees</td>
</tr>
<tr>
<td></td>
<td>Cost of project report</td>
</tr>
<tr>
<td><strong>5. Foreign Technicians &amp; Training abroad</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expenses for foreign technicians for plant set-up</td>
</tr>
<tr>
<td></td>
<td>Expenses for training of personnel abroad</td>
</tr>
<tr>
<td><strong>6. Other fixed assets</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Utilities – Boilers, transformers, compressors etc.</td>
</tr>
<tr>
<td></td>
<td>Office equipment &amp; furniture</td>
</tr>
<tr>
<td></td>
<td>Vehicles</td>
</tr>
<tr>
<td><strong>7. Preliminary expenses</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project identification, market survey, feasibility study.</td>
</tr>
<tr>
<td></td>
<td>Company formation and equity issue expenses etc.</td>
</tr>
<tr>
<td><strong>8. Pre– operative expenses</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers all expenses of revenue nature prior to completion of project &amp; commencement of production.</td>
</tr>
<tr>
<td></td>
<td>Project Office running expenses, salaries &amp; wages</td>
</tr>
<tr>
<td></td>
<td>Travelling &amp; conveyance, rents, taxes, insurance etc.</td>
</tr>
<tr>
<td></td>
<td>Interest &amp; commitment charges before completion</td>
</tr>
<tr>
<td></td>
<td>Start-up expenses</td>
</tr>
<tr>
<td><strong>9. Working capital Margin</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Working capital margin for the first year of operation</td>
</tr>
<tr>
<td><strong>10. Initial Cash Loss</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If the profitability projections show cash losses in the initial years of operation.</td>
</tr>
<tr>
<td><strong>11. Contingency</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provision for unforeseen expenditure and price escalation.</td>
</tr>
</tbody>
</table>
Principles of Project Cash Flows

1. **Incremental Principle** – The cash flows of project should be measured on incremental basis, i.e., the difference between cash flows with the project and without the project has to be ascertained. What it means is that only income/expenditure caused by the project are to be taken into account. If it is a Greenfield project then all the expenses are of incremental nature; whereas in case of existing organization, one has to identify the cost/income which would not have been there if project was not there.

**Fundamentals of Incremental Principle:**

(a) **Ignore Sunk Cost** – Outlay incurred in the past or expenses already committed irrevocably should not be considered. The expenditure that is not affected due to either acceptance or rejection of the project under consideration cannot be treated as project cash flow. Eg. : Land development cost incurred during an earlier project (abandoned) period. Such expenses are not to be brought forward to new project.

(b) **Consider Opportunity Costs** – Opportunity cost of diversion of available resources to the project should be included. The project may require some available assets. The company loses the opportunity to put them to any alternative use and generated revenue. The net value of such revenue should form part of project cash flow. Eg. A discarded machine which could have fetched, say, Rs 1,00,000, by second hand sale, is reappropriated to project. Even though company or project has no money to procure this machine, yet this amount of Rs 1,00,000 should be billed to the project as opportunity cost.

(c) **Consider Incidental Effects of Existing Project on the Present Operations** – Apart from the direct cash flows, the incidental effects on the company’s other operations must be considered. The project may enhance profitability of some of the existing activities of the company because it may have a complimentary relationship with them, or it may reduce profitability of some existing activities as it may have competitive relationship with them. These effects should be considered in the project cash flows.

Eg. Suppose you have a textile shop. Then you decide to start dealing in readymade clothes as well. Many of your old customers instead of buying cloth will chose to buy readymade clothes. Thus, sale of cloth business will get adversely impacted due to your new venture. This is competitive relationship. This loss is to be billed to project. But it is quite possible that new project brings in additional sales for existing business. Take the case of a tea shop deciding to expand into Paan-Bidi-Cigarettes business. Many new customers for tobacco products are bound to end up having tea as well. This is complementary relationship. Such benefits are to be credited to new project.
(d) **Overhead Allocation to be Reviewed** – Overhead costs not generated by the project should not be considered. Items such as general administrative expenses, managerial salaries, legal expenses, rents etc. that were already being incurred by the company and have not increased due to the project should not be allocated to project cash flows. Only incremental amount of overheads are to be debited to new project even though project uses facilities out of existing overheads.

2. **Long Term Fund Principle** – The ‘Long Term Funds’ principle evaluates project from the point of view of providers of ‘Long Term’ funds to the project. The benefits accrued to the suppliers of long term funds i.e. Equity and preference share holders, debenture holders, and term lending institutions, are compared with the sacrifices made by them for the project. Long term fund suppliers provide for outlays in fixed assets and margin for working capital. Benefits accrued to the suppliers of long term funds are cash profits after tax, interest paid on term loans, salvage value of fixed assets, and recovery of working capital margin.

   Interest on term loans is considered as an expense or cost while working out P & L account as per normal accounting principles. However, under the long-term funds principle, the term loan interest is considered as an accrued benefit. Hence, while working out the project cash flows, the interest on long term debt is either ignored while computing profits and taxes thereon or added back to the cash profits calculated by normal accounting procedures. These are then compared against the cost of long term funds that include interest and dividend payments. Following are the components of Long Term Funds –

   (a) **Initial Investment** – Fixed Assets + Working Capital Margin (portion of assets financed by long term funds)

   (b) **Operating Cash Inflows** – Profit after Tax + Depreciation + Other non cash charges + Interest on long term borrowings \((1 – \text{tax rate})\)

   (c) **Terminal Cash Flow** - Net salvage value of fixed assets + Net recovery of working capital margin

3. **Exclusion of Interest Cost / Finance Cost** – Financing costs of the long term funds should be excluded from analysis. This corroborates with the long term funds principle mentioned above. (Interest on long term funds to be added back to profits after tax). Example: amortization, export market development allowances, depreciation etc.

4. **Post Tax Basis** – All cash flows to be defined in post tax terms since the cost of capital is considered on post tax basis.

**Example – 2002 – 2(b)**

Following information is available about a proposed expansion project:
(a) Initial project outlay is Rs. 50 crores consisting of Rs. 40 crores fixed assets and Rs. 10 crores current assets.

(b) The financial pattern: Equity Rs. 15 crores, Term loans Rs. 30 crores, Working Capital advances Rs. 4 crores & Trade Credits Rs. 1.0 crores.

(c) Term loan repayable in ten equal six monthly instalments, the first instalment due 18 months after starting of production. Interest on term loan will be @ 12.0 % p.a. applicable on opening balance at the beginning of the year.

(d) The levels of working capital and trade credit remain unchanged till end. The interest on working capital advance will be @ 15 % p.a.

(e) Sales revenues are Rs. 65 crores p.a. while operating costs excluding depreciation & interest are Rs. 45 crores. Depreciation on fixed assets is charged @ 25% p.a. on written down value (W.D.V.) basis.

(f) Project life being 7 years, the salvage value will be Rs. 5.34 crores for fixed assets. Current assets recovery will be at cost.

(g) Average corporate income Tax rate is 40%.

Work out the project cash flows during its life from ‘long term funds’ point of view.

**Solution:**

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Asset</td>
<td>(40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working Capital Margin</td>
<td>(5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operating</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales Revenue</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Operating Cost</td>
<td>(45)</td>
<td>(45)</td>
<td>(45)</td>
<td>(45)</td>
<td>(45)</td>
<td>(45)</td>
<td>(45)</td>
<td>(45)</td>
</tr>
<tr>
<td>Interest on long term funds (*)</td>
<td>(3.6)</td>
<td>(3.6)</td>
<td>(3.24)</td>
<td>(2.52)</td>
<td>(1.8)</td>
<td>(1.08)</td>
<td>(0.36)</td>
<td></td>
</tr>
<tr>
<td>Interest on working capital</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>(10.0)</td>
<td>(7.5)</td>
<td>(5.63)</td>
<td>(4.22)</td>
<td>(3.16)</td>
<td>(2.37)</td>
<td>(1.78)</td>
<td></td>
</tr>
<tr>
<td><strong>PBT</strong></td>
<td>5.8</td>
<td>8.3</td>
<td>10.53</td>
<td>12.66</td>
<td>14.44</td>
<td>15.5</td>
<td>17.26</td>
<td></td>
</tr>
<tr>
<td>Tax @ 40%</td>
<td>(2.32)</td>
<td>(3.32)</td>
<td>(94.21)</td>
<td>(5.06)</td>
<td>(5.78)</td>
<td>(6.38)</td>
<td>(6.904)</td>
<td></td>
</tr>
<tr>
<td><strong>PAT</strong></td>
<td>3.48</td>
<td>4.98</td>
<td>6.32</td>
<td>7.60</td>
<td>8.66</td>
<td>9.57</td>
<td>10.36</td>
<td></td>
</tr>
<tr>
<td><strong>Add Back</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>10.0</td>
<td>7.5</td>
<td>5.63</td>
<td>4.22</td>
<td>3.16</td>
<td>2.37</td>
<td>1.78</td>
<td></td>
</tr>
<tr>
<td>Long term interest (1-x)</td>
<td>2.16</td>
<td>2.16</td>
<td>1.94</td>
<td>1.51</td>
<td>1.08</td>
<td>0.65</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td><strong>Net Operating</strong></td>
<td>15.64</td>
<td>14.64</td>
<td>13.89</td>
<td>13.33</td>
<td>12.90</td>
<td>12.59</td>
<td>12.36</td>
<td></td>
</tr>
</tbody>
</table>
Cash Flow

<table>
<thead>
<tr>
<th>Terminal Cash Flow</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(45)</td>
<td>15.64</td>
<td>14.64</td>
<td>13.89</td>
<td>13.33</td>
<td>12.90</td>
<td>12.59</td>
<td>22.70</td>
</tr>
<tr>
<td>Total Cash Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5.34+5)</td>
<td>10.34</td>
<td>(5.34+5)</td>
<td>10.34</td>
<td>(5.34+5)</td>
<td>10.34</td>
<td>(5.34+5)</td>
<td>10.34</td>
</tr>
</tbody>
</table>

Calculation of interest on long term funds

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outstanding Balance</td>
<td>30.0</td>
<td>30.0</td>
<td>27.0</td>
<td>21.0</td>
<td>15.0</td>
<td>9.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Repayment</td>
<td>-</td>
<td>3.0</td>
<td>6.0</td>
<td>6.0</td>
<td>6.0</td>
<td>6.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Carried Forward Balance</td>
<td>30.0</td>
<td>27.0</td>
<td>21.0</td>
<td>15.0</td>
<td>9.0</td>
<td>3.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Interest</td>
<td>3.6</td>
<td>3.6</td>
<td>3.24</td>
<td>2.52</td>
<td>1.8</td>
<td>1.08</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Emergence & development of ‘Venture Capital’ Financing in India.

Concept of venture capital vis-à-vis traditional security oriented approach – Venture capital is primarily for the kind of novel business ideas that have good market potential but have not been tested in the market. Therefore, they do not have any background to base the projections. Since they get first mover’s advantage, they tend to reap huge profits if successful. But such ventures could also suffer very heavy losses if the new product is not accepted in the market.

Financial Institutions have traditionally been very guarded and security oriented in their lending practices to minimise the risk of loss and therefore were unwilling to take chances with untested products. Many new promising business ideas floated by unknown entrepreneurs died due to lack of finance. As such, obtaining license to start a new venture was more difficult to accomplish than generating a promising idea. As a developing nation, availability of capital was also scarce and priorities were naturally towards comparatively risk free investments.

Once the financial sector begun to open up under economic liberalisation, foreign investors who are more familiar with the venture capital business, began to actively seek novel business ideas for financing. IITs, IISc and top Business Schools became their favourite hunting ground for such novel products/business concepts. Indian Financial Institutions were quick to spot this trend and realised the possibility of very high returns by backing promising ventures after due evaluation of their potential.

Venture Capital Funds in India – Many financial institutions such as ICICI, GIIC, IFCI, Can Bank, HDFC, etc. have set-up their venture funds and there are many private funds also. There are 87 Venture Capital Funds registered with SEBI as on 28 Feb 2007. Although there are no financiers purely in venture capital field, most are allocating about 5% to 10% of their investible funds for venture financing to adequately cover for the risk of failures in some cases.
Q. How do the parameters and characteristics of ‘Project Investment’ decisions differ from that of routine manufacturing decisions? What are the main difficulties in preparing and analysing capital investment decisions?

Ans. Differences

<table>
<thead>
<tr>
<th>Projects</th>
<th>Routine Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>The effect (gains/losses) is in distant future</td>
<td>Effect is in immediate future</td>
</tr>
<tr>
<td>Investment/Outlay is often much larger</td>
<td>Only working capital investment</td>
</tr>
<tr>
<td>Far greater uncertainty about results</td>
<td>Little or no uncertainty</td>
</tr>
<tr>
<td>Much greater impact on company’s fortunes</td>
<td>Minor impact on company’s fortunes</td>
</tr>
</tbody>
</table>

Difficulties in preparation and analysis of capital investment decisions –

(a) **Uncertainty** – Most of the important factors, like, are demand, taxes, parallel capacity, price movements, time, govt policies, etc, are uncertain.

(b) **Measurement Problems** – Measurement of costs and benefits is difficult when so many of major factors are uncertain.

(c) **Long Spread** – Projects often live for long period of 5 ~ 20 years. It is difficult to make projections beyond 5 years.

**Break-Even Analysis in Investment Decisions**

The manufacturing capacity is decided on the basis of estimated peak market demand within the constraints of decided budget for the project. However, it is not possible to run the plant at its full capacity from the beginning due to various reasons, such as, time taken for market development, time for process stabilization, learning, etc. It is, therefore, a generally accepted practice to reach the full manufacturing capacity in stages over a period of time. Secondly, market demand is not constant. It keeps fluctuating. However, it is uneconomical to operate the plant at a lower capacity as the fixed costs do not get scaled down in proportion of the utilised capacity and they more or less remain constant. It is, therefore, necessary to know the minimum operating capacity at which project does not incur any losses. This operating capacity is known as ‘Break-even capacity’. A capital intensive high fixed cost project will have a much higher break-even point than low technology, high variable cost project.

Break–even capacity is calculated by dividing fixed costs by the unit ‘contribution margin’ of the product.
Break even point = \[ \frac{\text{Fixed Costs}}{\text{Unit Selling Price} - \text{Unit Variable Cost}} \]

**Q. How would you treat the following items in project cash flows?**

- **Cost of project feasibility study carried out before final approval of the project.**
  
  Sunk cost. Should not be included.

- **Cost of existing idle machinery/equipment transferred to new project.**
  
  Since there is no opportunity otherwise to put the machine to any use, not to be included. However, if there is any resale value as second hand sale or even scrape sale, same should be billed to the project.

- **Portion of Head Office administrative expenses allocated on project.**
  
  Allocated overheads. Should not be included.

- **Cost of land purchased in excess of current project requirements.**
  
  Since the excess land is not required for the project, its cost cannot be considered incremental cost related to project. Hence not to be included.

**Project Cash Flows**

Estimating the cash flows – investment outlays and the cash inflows after the project is commissioned – is the most important as well as most difficult step in capital budgeting. Forecasting errors can be crippling. Take for instance – Building of Alaska (US) pipeline by a consortium of oil companies. Initial estimates were $700 million. And the final bill – $7 Billion! Not that such horrendous errors happen regularly but errors of even 25-30% are enough to affect viability of project.

Cash flows affect the project from two angles; one – Quantum of funds (inflows and outflows); two – Time of requirement/availability (Time value of money). Hence calculating project cash flow is important.

**Elements of Cash Flow**

1. **Initial Investment** – After tax cash outlay on capital expenditure and net working capital when project is set up.

4. **Operating Cash Inflows** – After tax cash inflows from operations of the project during the economic life of project.

5. **Terminal Cash Inflow** – After tax cash inflows from liquidation of project at the end of economic life of project. In some cases, liquidation of project involves
additional expenditure like demolition cost of temporary structures or repairing the
damages. Then such cash flows become outflows. There are various kinds of
project lives –

(a) Physical life of plant
(b) Technological life of plant
(c) Product Market life of plant

Q. What is the criterion used for determining ‘Life’ of the project for
determining time span of cash flow projections?

Ans. The life of project is considered to be minimum of the following –

(a) Physical Life of Plant – Period for which the plant remains economically
and technically functional and productive. Plant productivity declines due to
normal wear & tear during its use it becomes uneconomical to maintain
beyond certain period.

(b) Technological Life of Plant – New technologies and processes make
existing plants obsolete even before they are physically worn out.

(c) Product Market Life – Markets for a product shrink, change or disappear
due to changes in consumer preferences, emerging competition etc. making
continued production unjustifiable.

(d) Investment Planning Horizon of the Company – Time period for which
the company wishes to look ahead as it’s long term investment policy.

When any one of the above occurs, the project cannot be expected to run
remuneratively. Hence cash flow projections are carried out only up to that time.

Q. Why is ‘Margin Money’ for working capital required to be provided as
‘Initial Investment’ for the first year of operation?

Ans. The commercial banks financing the working capital requirements against the
security of current assets do not finance 100% needs but specify certain margin to
be provided by the company from their own resources. Such margin money is
generally provided from the cash surplus generated during the operational phase.
However, there is no such surplus generated out of project operations at the
beginning the first year of production and the margin requirements are to be
provided from the long term funds as initial investment and is included in ‘cost of
project’.
Q. Explain the reasons for using ‘Weighted Average Cost of Capital (WACC) as a ‘Hurdle Rate’ for Discounted Cash Flow (DCF) analysis. What are the limitations in using WACC as constant rate of discounting throughout the project life span?

Ans. The DCF analysis is carried out with cash flows worked out from ‘Long Term Funds’ point of view. WACC indicates the average rate of expectation from the providers of long–term funds to the project. A positive NPV after discounting the project cash flows at the WACC indicate that the project generates surplus in terms of present value after meeting the expectations of all the long–term fund providers. Hence the WACC is considered as a ‘hurdle rate’ for DCF analysis.

Rate of discounting generally represents the rate at which the project surplus is reinvested. Using a constant rate of discounting therefore assumes that the surplus is reinvested every year at the same rate. However in reality, opportunities for reinvestment keep changing from time to time making it necessary to consider different rates of discounting for different years.

Q. What are the relative merits of building a project budget from ‘bottom–up’ and from the ‘top–down’ methods?

Ans. ‘Top Down’ method of project budgeting is a quick and economical method to prepare project cost estimates with reasonable reliability when the detailed information about the project parameters is not available. It is also known as analogous estimation as it uses actual costs of previous similar project as a basis. However, reliability depends on the degree of similarity between projects, scalability of parameters and expertise of the estimating team in given field.

‘Bottom Up’ method involves estimating the cost of individual work items in the Work Breakdown Structure (WBS) and then summarizing or rolling up the individual estimates to get a project total. Cost of estimation and its accuracy depends upon size of individual work item in the WBS. Smaller work items increase time and cost of estimation but also increase its accuracy.

Q. Explain the methods for comparing and ranking projects with different life–spans. Explain also the rationale behind these methods.

Ans. Direct comparison of NPV for projects with different lives may lead to wrong conclusion since it does not indicate what does the firm do after expiry of the shorter life project if it is selected. Therefore it is necessary to make a choice between projects with different lives by evaluating them for equal periods of time. There are two methods that are used for such comparison.

(a) Common Time Horizon Method— (Also known as Least Common
Multiple (L.C.M.) Method) When two or more projects with different life spans are to be compared, the L.C.M. of their lives is found out. Each of the projects is then repeated by assuming that the investment is replaced in its last year and these replacement chains are extended till the time equivalent to the L.C.M. of lives. A combined NPV for each project is found and compared. This method may become cumbersome if the L.C.M. is high e.g. L.C.M. for two projects with lives 5 & 7 years ill be 35.

(b) Annual Equivalent Value (AEV) Method – An annuity value equivalent to the NPV of each project is found out by dividing the NPV by annuity factor for the given rate of discounting. It is assumed that the chain of cash flows for a project is equivalent to having equal cash flows given by the annuity value. The project that gives a better AEV is chosen.
PROJECT MANAGEMENT

Q. How does project management differ from the management of other types of manufacturing activities?

Ans. Project Management Vs Manufacturing Plant management

<table>
<thead>
<tr>
<th>Element</th>
<th>Project</th>
<th>Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time horizon for planning</td>
<td>• Long term; usually much more than one year.</td>
<td>• Short &amp; medium term, usually within one year.</td>
</tr>
<tr>
<td></td>
<td>• More strategic thinking involved.</td>
<td>• Focus on minor day to day issues</td>
</tr>
<tr>
<td>Processes &amp; Methodology</td>
<td>New process/method has to be developed &amp; designed for each project.</td>
<td>Well stabilised and proven processes employed. Almost nil uncertainty due to experience,</td>
</tr>
<tr>
<td></td>
<td>Considerable uncertainty and many unknown factors</td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td>New multi-disciplinary team to be created usually from personnel from</td>
<td>Plant &amp; personnel already exist. Direct control over personnel.</td>
</tr>
<tr>
<td></td>
<td>other departments.</td>
<td></td>
</tr>
<tr>
<td>Change management</td>
<td>Projects are initiated to bring about change.</td>
<td>Minimal change is expected in set routine.</td>
</tr>
<tr>
<td>Capital outlays</td>
<td>Substantially Large</td>
<td>Comparatively smaller</td>
</tr>
</tbody>
</table>

Q. Differences in planning and handling of projects by EPC (Engineering Procurement and Construction) companies and companies setting up own diversification / expansion project organisation –

Ans.

<table>
<thead>
<tr>
<th>SNo</th>
<th>EPC PROJECT ORGANISATIONS</th>
<th>OWN PROJECT ORGANISATION FOR DIVERSIFICATION/EXPANSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sets up projects for clients</td>
<td>Set up projects for own requirements</td>
</tr>
<tr>
<td>2</td>
<td>Project execution is revenue generation activity and profits are booked on completion of project.</td>
<td>Project is capital expenditure decision &amp; profits are generated over a long period of time only after project completion.</td>
</tr>
<tr>
<td>3</td>
<td>EPC company is not concerned with future market risk</td>
<td>Future market risks affect project profitability.</td>
</tr>
<tr>
<td>4</td>
<td>No project feasibility report required. Only accurate cost estimation is needed.</td>
<td>Project feasibility report is a must for decision making &amp; financing.</td>
</tr>
<tr>
<td>5</td>
<td>Only Short term financing required as working capital for project execution</td>
<td>Long term financing required for investment in fixed assets.</td>
</tr>
</tbody>
</table>
6 Company has expertise in project technology & project set up.  
May not have expertise in project technology & project set up.

7 Schedules, Costs & Performance can be closely controlled due to available expertise & information data base.  
Schedules, Costs & Performance are difficult to control since it is the first time project experience.

8 Regular and experienced contractors & associates make implementation easier.  
New contractors & consultants take time to get acquainted.

Validity of trend analysis in demand forecasting for project feasibility

Demand forecasts made on the basis of market trend data are subject to error and uncertainty due to various reasons. Some of them are –

(a) Errors in Forecasting Process - Conclusions may not be statistically reliable due to inadequate sample size or may be influenced by certain abnormal factors. Methods of forecasting are characterised by certain limitations such as inability to handle unquantifiable factors, errors due to unrealistic assumptions and processing needs of excessively voluminous data. AT&T, despite being the first to develop mobile phone technology, made error in estimation of demand for mobile phones and did not launch it.

(b) Technological Changes - Technological changes cut the lifecycle of products abruptly. A new process which could be substantially cost effective or substitute which could be considerably cheaper or superior in quality or function may turn an otherwise perfectly valid forecast on its head. MTNL and BSNL who had a waiting line running into years till some time back, have not takers today for their landlines due to advent of mobile phone technology.

(c) Environmental Changes - Change in business environment like govt policy are hard to predict and can alter the demand growth pattern drastically. Bajaj Scooter at one time had a queue over 5 years long. Due to economic liberalisation, today Bajaj is queuing at the doors of prospective customers along with other two wheeler manufacturers.

Earned Value Method of Project Management/Evaluation

Budgeted cost of the activity is treated as its ‘Earned Value’. When the activity is complete, it is assumed to earn ‘Value’ for the project equivalent to it’s budgeted cost, irrespective of the actual expenditure incurred.

Earned Value method is the most comprehensive trend analysis technique for project management. Current performance is the best indicator of future performance and therefore
using trend data it is possible to forecast cost or schedule overruns at quite an early stage in a project.

Earned Value provides the project manager with an objective way of measuring performance and predicting future outcomes. This can enable him/her to report progress with greater confidence and highlight any overrun earlier. This in turn enables the management team to make cost and time allocation decisions earlier than would otherwise be the case.

In a nutshell Earned Value is an approach where you monitor the project plan, actual work and value of completed work to see if a project is on track. Earned Value indicates how much of the budget and time should have been spent, with regards to the amount of work done to date.

Earned Value differs from the usual budget verses actual costs incurred model, in that it requires the cost of work in progress to be quantified. This allows the project manager to compare how much work has been completed against how much he expected to be completed at a given point.

As each work package is completed (earned) it is compared with planned value, showing the work achieved against plan. A variance to the plan is recorded as a time or schedule deviation.

Earned Value is also known as Performance Measurement, Management by Objectives, Budgeted Cost of Work Performed (BCWP) and Cost Schedule Control Systems.

**Concepts**

The *Budgeted Cost* of each activity is considered as its *Value* for the project. Hence completion of an activity is considered to contribute *Value* equivalent to its *budgeted cost* to the total value of the project. In other words, an activity *Earns Value* equivalent to its *Budgeted Cost* on its completion. An activity that is partially completed on a particular date is also considered to have earned value equivalent to its percentage completion on the given date multiplied by its total budgeted cost.

In case Actual Expenditure incurred for completion of an activity exceeds its Budgeted Cost, the project does not Earn any additional benefit since activity parameters are well specified. The variance therefore indicates cost over–run.

The *Total Value Earned* for the project on any given date is the total of *Earned Values* of all the completed activities till date as well as the total of *Earned Values* to date for partially completed activities. The ‘S’ curve drawn between the *Planned Cumulative Earned Value* for the project against the Time; based on *Early Start Schedule*; will indicate the total planned expenditure for the project at any given point of time during its progress.
Basic Functions of a Project Manager

(a) **Planning & Control** – To develop the project plan and ensure that the work is completed on time, within budget and with acceptable quality.

(b) **Organisation and Management of Resources** – Organise necessary resources and manage them to achieve project objectives.

(c) **Direct** – Direct the project activities to avoid any time and cost overruns.

(d) **Coordination** – Interface with higher management and with internal and external units regarding project review, approvals and project issues. Also relate successfully to line managers and staff.

Qualities, Qualifications & experience to be a successful project manager

(a) **Personal Qualities** –
   (i) **Planning ability**
   (ii) **Maturity** to take things in their stride and sense of timing to make certain moves.
   (iii) **Toughness** and willingness to take contrary positions rather than taking an easy way out, or to take a path of least resistance or to cave in to the pressure.
   (iv) Ability to take directions, suggestions, hints and criticism and converting them in positive action.
   (v) **Communication skills** both, written & oral
   (vi) **Energy** to deal with problems and work hard
   (vii) Ability to take measured risk.
   (viii) **Go getter attitude**

(b) **Managerial Qualities** –
   (i) **Good Interpersonal Skills** – Project management is more about management of people than resources. Ability to negotiate your way through seniors and subordinates in a situation as dynamic, uncertain and overlapping as projects is the key to success.
   
   (ii) **Conflict Solving Ability** – With regular overlap of activities and many claimants for limited resources, conflicts are inevitable part of projects. Such conflicts if not resolved amicably can lead to costly delays and other problems.
   (iii) **Problem Solving Capabilities** – In an largely unstructured set up of
projects, unanticipated problems crop up every now and then. Ability to understand problems, place them in perspective, develop and implement solutions is key to achieving the goals.

(iv) **Perspective vision** to step back and take an overall view to see symptoms of problems and way ahead.

(v) **Good Time Manager/Ability to Delegate** – Problems and activities are overwhelming. Management of time is vital requirement. No project manager can survive a day without ability to delegate tasks and authority.

(vi) **Familiarity** with the organisation to understand funding and decision making process.

(vii) Initiative and risk taking ability to accept / delegate tasks.

(c) **Technical Skills, Knowledge & Experience**–

(i) **Knowledge** of latest project planning, budgeting and control techniques.

(ii) **Generalist.** Should be a generalist to be able to see a bigger picture i.e. relationship of project to the company, impact of end product, etc.

(iii) **Experience** of not only working on several projects but to integrate it to apply to the current project

(iv) **Quick Grasp.** Acquire knowledge and information on all aspects of project and quickly.

(v) **Technical Appreciation.** Basic understanding and appreciation of technical process is required rather than vertical specialisation in the same.

**Q. Discuss human aspects of project management in relation to Authority, Personnel Orientation, Motivation and Team Building.**

**Ans.** It is an old saying that man behind the machine is more important than the machine. This saying is even more valid in an unstructured set up like projects. All the project planning and control tools can only assist the Project Manager in planning and forecasting. But eventually those plans have to be executed by people. How effectively is the execution is largely a function of performance of people on ground executing various activities.
Interpersonal conflicts are inevitable part of projects but minimising them is the key to successful completion of projects. It is, therefore, very important to understand human nature and to achieve satisfactory human relations among the project team. Project manager has to handle problems and challenges relating to following issues–

(a) **Authority** – Project managers very often have to be content with split authority and dual subordination in their set-up (with the exception of Divisional form of Organisation). In addition, with all the criss-cross and overlap of responsibilities and paucity of resources and its sharing, assigning blame is rather difficult.

In such a difficult situation, a project manager has to rely on the informal authority, ie, his rapport with project personnel. His skills in resolution of conflicts, skills of communication and persuasion ability and ability to act as a link between technical, engineering, financial and commercial personnel is what gives him the real authority over his people.

(b) **Personnel Orientation** – Most of the project managers are engineers who have science background. In scientific world, most of the things are well defined, structured and with a degree of certainty. Thus, they are accustomed to those well structured and defined forms. Human psychology plays very minor role in such set-up.

Projects are almost diagrammatically opposite world to a typical engineer’s world. It is an unstructured world where little is defined and full of uncertainties. And half the uncertainties emanate from people’s mood. An ego hassle over a total non-issue between two key personnel can hold up the project for days despite availability of all the resources.

Thus, personnel management is the key to successful execution of projects. Therefore, project manager has to transform the technical orientation of his managers to personnel orientation.

(c) **Motivation** – Performance of people is dependent on their motivation. In an unstructured set-up, where standards of performance are hard to define, motivation assumes further importance. But with split authority and dual subordination, as in case of Matrix Organisational structure, keeping people motivated becomes very difficult. In a dual subordination set-up, rewarding people is little difficult and handing punishment is even more difficult. His other superior under whom he works on permanent basis is always there to provide an alibi to cover up his failures.

Projects give people a chance to perform tasks which are clearly defined and visible. If the project manager is appreciative and gives public applause to performance/contribution, it motivates the personnel greatly. Participative style of management gives a sense of authority and ownership
to personnel, which keeps them further motivated.

(d) **Team Building** – Most of the project activities are inter-related and inter-dependent and most of the problems need inter-disciplinary solutions. Successful management of project therefore is not possible without proper teamwork. Development of mutual trust and respect for each other, open communication and mutual cooperation have to be achieved at whatever cost.

**WBS (Work Breakdown Structure)**

A Work Breakdown Structure (WBS) is a fundamental project management technique for defining and organizing the total scope of a project, using a hierarchical tree structure. The first two levels of the WBS (the Root Node and Level 2) define a set of planned outcomes that represent 100% of the project scope. At each subsequent level, the children of a parent node collectively represent 100% of the scope of their parent node. A well-designed WBS describes planned outcomes instead of planned actions. Outcomes are the desired ends of the project, and can be predicted accurately; actions comprise the project plan and may be difficult to predict accurately. A well-designed WBS makes it easy to assign any project activity to one and only one terminal element of the WBS.

What is very important to note here is that WBS is NOT breakdown of activities but of outcomes. Each node is an event (result of a group of sub-events) and not an activity.

It is constructed by dividing project into its major parts, each of which is further subdivided in a tree like structure. This subdivision process is continued till the breakdown reaches such manageable level where schedule, cost and responsibility can be clearly defined for each event. WBS therefore helps in –

(a) Effective planning of the project by dividing large project into manageable elements that can be easily monitored.

(b) Costs and responsibilities can be assigned to the lowest levels and summarised at the higher levels of the structure.

(c) Effective planning, monitoring and controlling structure can be developed.

(d) Effective information system is developed with help of proper codification for cost accounting and progress reporting.

**Q. Preparing a ‘Project Work Breakdown Structure’ (W.B.S.) is said to be the first step in project planning – especially, scheduling, & budgeting.**
Explain.

Ans. Work breakdown structure is a breaking down of project into smaller, manageable, and easily measurable elements. The breakdown is carried out at various levels such that the lower level elements contain the components of its higher level element. The lowest level thus broken down is generally known as a ‘work package’. The total project estimates and budgets can be developed either on ‘Top–down’ or ‘bottom–up’ basis for each work package. Responsibilities are assigned to individuals/contractors for completion of work packages.

Each element of work package is further broken down to define tasks or activities that are required to be performed for its completion. These activities are used as basic elements for scheduling where time estimates and inter–relationships are defined to prepare a project network. Resources required to perform various activities are also assigned so that activity-wise costs can be worked out for cost control purposes.

Q. Explain how the cost breakdown based on project activities helps in effective cost control of the project. Which are the main cost figures to be tracked by a project manager to achieve such control over project costs?

Ans. When budgeted cost for each work package is broken down further to indicate budgeted cost for each activity, it forms the basis for project cost control. The actual cost incurred can be found out either as soon as the activity is completed or even while the activity is under progress. This enables the project manager to take timely controlling action as soon as any deviations from the budgeted costs for the current state of physical progress are noticed.

Regular & periodic reporting of project costs is done under the following summary heads–

(a) **Committed Costs** – Total value of all works and expenses contained in contracts and purchase orders awarded to third parties. In case of reimbursable or measured works contracts, committed costs are in relation to defined scope of work.

(b) **Sunk Costs** – Total costs, at a given time, which would be incurred should the project be cancelled.

(c) **Project Expenditure** – Total cost of work done, goods received and of services used, whether or not these have been paid for or received. This includes accruals & provisions.

(d) **Outstanding Commitments** – Total costs committed minus project expenditure.
(e) **Estimate to Complete** – It is the best estimate that can be made at any given time of remaining costs not already reported as expended or committed, taking into account the current project scope and performance trends.

(f) **Estimated Final Cost** – It is committed costs to date plus the estimate to complete.

(g) **Earned Value** – Total of budgeted cost for the work progress to date.

**Project Monitoring & Control Cycle**

Project implementation phase starts after the project activity schedule is planned, budgets are allocated and responsibilities are assigned. In order to achieve effective control over the implementation, it becomes necessary to assess the progress from the start at regular intervals in terms of actual completion of scheduled activities, actual cost incurred in performing those activities and achievement of desired performance levels vis-à-vis plan. This assessment process is known as ‘monitoring’ Monitoring exposes the deviations from the plans. While positive deviations are exploited to compress cost and duration of the project, negative deviations are assessed in terms of their impact on overall cost and schedule of the project. Controlling actions are taken if needed to correct the deviations to the extent possible and to bring the project back on its planned course. Schedules, budgets and performance parameters are revised as a result and reissued for further execution. Actual controlling actions are carried out by the persons authorised and responsible for the activities and involve efforts and assistance by entire project team.

**Q. How do you differentiate between the terms ‘Project Monitoring’ and ‘Project Control’? Explain the Project Monitoring & Control Cycle.**

**Ans.** Project monitoring is a process of

(a) Assessing the current status of the project progress in terms of schedule, cost and performance parameters;

(b) Analysing deviations from base line schedule, budgets and acceptance criteria;

(c) Evaluating implications of deviations on total project completion cost, time and final performance, &

(d) Suggesting alternative strategies in order to bring the project on track

Project control on the other hand –

(a) Plans and decides on action plan to correct the deviations
(b) Redistributes revised schedules, budgets, and specifications for execution.

(c) Designates/Delegates authority and responsibility to carry out the control actions

**Q. Explain why and how the project budgets are broken-up on the basis of project activities to achieve effective cost control.**

**Ans.**

(a) Project budgets are initially prepared to conform to the asset classification required by the financial institutions. This classification is generally based on depreciation/amortisation rates and capitalisation rules in accounting procedure, tax and company statutes.

(b) Such classification is not useful for control as it is more suitable for historical information and does not reflect the time and manner in which the expenditure is to be incurred.

(c) Costs are incurred and become due in a project as various project activities are being performed, by deploying resources.

(d) Time and costs are therefore inseparably linked and it is not possible to control costs without linking them with time schedule of activities.

(e) It is therefore necessary to identify costs with the work involved in project activities.

(f) The total cost budget is broken down as per WBS at different levels upto its last level representing individual activity.

(g) When the duration or schedule for the particular part of the project or for the individual activity are changed, the cost incidence also changes accordingly.

(h) Finer the WBS, more flexible and accurate will be the control.

(i) Techniques such as ‘Earned Value’ and ‘S’ curves help in keeping cost and schedule control in an integrated manner.

**Importance of Entrepreneurial Abilities in Project Managers**

A project has almost every element of an entrepreneurial venture. And a project manager, like an entrepreneur needs to posses all the qualities required to make a new project successful. Following are the key qualities and traits of an entrepreneur:

- Need for Achievement
- Risk taking
- Organizing Skills
- Perseverance
- Hard work
- Leadership
- Innovation

(a) **Need for Achievement** – A project manager has to be yearning for success like an entrepreneur to overcome all the obstacles that he faces in project situations.

(b) **Risk Taking** – Projects keep throwing all the uncertainties and options with each situation is impregnated with pitfalls and gains. Most often there is no certain way to arrive at the best choice. Safest choices are also least paying. Therefore, the project manager has to learn to take calculated risks like an entrepreneur.

(c) **Organising Skills** – An entrepreneurial venture and project are like twins in this respect. Both are very high on uncertainties and require tremendous amount of organising skills to succeed.

(d) **Perseverance** – Some set backs are inevitable in projects like in case of entrepreneurial ventures. Project Managers have to be able to take those failures in their stride and carry on regardless.

(e) **Leadership** – Project manager needs strong leadership qualities that enable ordinary persons to accomplish great feats. They have to motivate their team to successfully cope with the challenges and frustrations inherent in a new venture.

(f) **Hard work** – Any set-up that is as unstructured as a project or entrepreneurial venture with so many unknown variables is bound to throw up innumerable challenges. The physical environment is often inhospitable (especially in case of green field projects) and amenities are few. Hard work is the only key to unravel them.

**Causes of Project Failures**

A project is considered to be a failure if it fails to complete in scheduled time or it exceeds the budgeted cost or is not able to fully accomplish the project objectives. While time overruns and cost overruns are the common causes of project failure; inability to meet the key performance indicators is also observed occasionally. Although the project is may not be a total failure as it is finally implemented and starts functioning, it tends to be uneconomical to run, does not create sufficient surplus for investing into future growth of the organization and eventually becomes a drain on organizations’ funds.
There is a long list of causes for project failure. Some of them are listed below –

(a) Inadequate project formulation
   (i) Superficial field investigation
   (ii) Cursory assessment of input requirements
   (iii) Slip–shod methods for cost & benefits estimation
   (iv) Omission of project linkages
   (v) Flawed judgement due to lack of experience & expertise
   (vi) Undue hurry to get started

(b) Unsound Project Organization
   (i) Incompetent project leader
   (ii) No accountability for performance.
   (iii) Authority not commensurate with responsibility.
   (iv) Neglected human aspects.
   (v) Systems & methods not clearly defined

(c) Inadequate planning for implementation
   (i) Unrealistic schedules
   (ii) Improper or inadequate methods for monitoring and control.
   (i) Poor resource planning.

(d) Other factors that may contribute to project failure are
   (i) Irregular and inadequate availability of funds
   (ii) Flaws in tendering, procurement and contract administration.

Q. Do you think that the specialised project management techniques can be applied effectively to non-engineering areas of organizational functions? Explain your answer with suitable examples.

Ans. Project management has become a proven approach to achieving specific objectives in time. If properly applied, project management techniques supply structure, focus, control and help to drive a team to the completion of work. Today, the definition of a project has expanded to include one time crisis, dealing with difficult issues, and
even some kinds of recurring situations, so that projects and project management apply to various business situations that have to deal with complexity. Legal offices, hospitals and other services as well as traditional manufacturing firms have become enthusiastic about the ways in which project management is improving their delivery of services or creation of new products. Some typical examples are–

- Annual budgeting / auditing exercises
- Introduction of new systems (ISO 9000)
- Organizational restructuring
- Software development & implementation
- Development of new product
- Campaign for new product launch
- Organizing AGM / sales conference

Effect of Contract Management.

Since substantial portion of projects is typically executed through contracts/subcontracts, proper management of contracts is critical to successful implementation of project. It is, therefore, necessary to devise a suitable contracting strategy that achieves optimum balance in the cost-time-performance risks to be shared between the contractor and the client. Fixed Cost or lump sum fee contracts (EPC – Engineering Procurement and Construction contracts or LSTK – Lump Sum Turn Key contracts) put the entire risk on the contractor while in ‘Cost Plus’ contracts the client bears the entire risk. In various other types of contracts, the risk sharing is in different degrees. It is also further necessary to ensure the following–

(a) Ascertain technical competence and financial capabilities of the contractor.
(b) Establish proper relationship and coordination between contractors and suppliers.
(c) Penalty/Bonus clauses should be included in contracts and should be properly administered.
(d) Contractors should be considered as partners in a common pursuit and help and cooperation should be extended when genuinely required.

Q. Over the period of project implementation phase, the project scope may need modification. How should such changes be managed?

Ans. During the implementation phase of the project, scope may need modification as a result of–

(a) An external event, like change in government regulations, development of
new production technology, launch of a competitive substitute, etc.

(b) An error or omission in defining scope of the product or project initially.

(c) A value adding change, enhancing project benefits.

Any such modification should be carried out in such manner that corresponding changes in time of completion, budgeted costs and performance parameters due to change in scope get proper authentication, sanction and approval.

To manage and control the scope change, following procedure may be adopted–

(a) The scope base line is first defined by work Breakdown Structure (WBS)

(b) Establish scope change control system that defines the procedure by which scope is to be changed. This includes paperwork, tracking systems, and approval levels and authorities necessary for authorizing changes.

(c) Monitor project performance for scope compliance from time to time. Any deviations should be scrutinized to assess the need for scope change in future.

(d) Keep track of change requests oral or written, direct or indirect, externally or internally initiated, legally mandated or optional.

(e) Evaluate effect of the scope change (either expansion or shrinkage) on schedule, cost and performance and Initiate action to formalize the changes.

(f) Issue revisions in schedule, budgets and performance parameters on the basis of approved changes.
**PROJECT ORGANISATION**

**Q.** Why is the traditional ‘Functional’ organization not considered suitable for implementation of projects in general? Name the other organization structures developed stating the types of projects these are found to be more effective.

**Ans.** The traditional ‘Functional’ organization is not suitable for implementation of projects in general because—

(a) No single individual is directly responsible for total project. No formal authority.

(b) It does not provide project oriented emphasis necessary to accomplish project tasks.

(c) Needs excessive lead time for approval of decisions due to complex coordination.

(d) Decisions normally favour strongest functional group.

(e) There is no customer focus.

(f) Slow response to customer needs.

(g) Difficult to pinpoint responsibility.

(h) Individual motivation and innovation are on low scale.

**Other Types of Organisations**

(a) **Pure Project Organization** – A ‘Pure Project’ organization is a separate division developed within the company with independent authority and responsibility for project. Such organization is suitable for companies embarking on major diversification / expansion projects generally at sites away from the parent organization.

(b) **Matrix Project Organization** – A ‘Matrix Project’ organization combines the attributes of Functional & Pure Project Organizations. While retaining the basic functional structure, it identifies independent authority and responsibility for a project with a project manager. Such structure is found generally suitable for organizations engaged in project implementation for the clients as their main business. Construction contractors, EPC companies etc. are some examples.
Q. Explain the organization structure of a ‘Pure Project’ type of organization with an organization chart and enumerate its advantages and disadvantages. For what types of projects such organization is more suitable?

Ans. Pure Project organization is a fully dedicated organization created for project implementation and is separated from the parent system with its:

- Own technical staff
- Own administration
- Give parent firm periodic reports and overview

![Organization Chart for Pure Project Organization](image)

**Advantages** –

A pure project type organization is more suitable to handle a own diversification project because –

(a) Project Manager has a complete line authority over project personnel.

(b) Individual authorities and responsibilities can be clearly spelt out.

(c) Faster & effective communication due to simplicity of organization. Therefore, faster reaction.

(d) Facilitates better planning & control
(e) Better personnel morale & team spirit can be built-up through motivation by the Project Manager.

(f) Project personnel are more committed to project goals.

(g) Quicker decisions and faster reaction / response time.

**Disadvantages**–

(a) Duplication of efforts, facilities, & personnel

(b) Stockpile equipment and Technical Assistance

(c) Project takes on a life of its own.

(d) No perpetuation of technology

(e) Lack of opportunity for technical interchange between projects

(f) Lack of career continuity for personnel.

The ‘Pure Project’ type organization is suitable for expansion / diversification projects of a company either being implemented at a site that is remote from the existing facilities or for the projects that are in a completely diverse fields.

**Q. Who are normally the stakeholders in a project? What is the role of project manager vis– à– vis stakeholders’ expectations?**

**Ans.**  Project stakeholders are individuals or organizations whose interests may be positively or negatively affected as a result of project execution or its successful completion. Key stakeholders in a project include project manager, customers, performing organizations and project sponsors. In addition, owners and funders, suppliers and contractors, team members and their families, government agencies and media outlets, individuals, temporary or permanent lobbying organizations and society at large are also stakeholders.

Managing stakeholders’ expectations is always difficult because various stakeholders have different objectives and interests, which may be in conflict with each other and with the project objectives. Project manager has to understand these expectations and achieve a judicious balance in the interest of successful project implementation. Project manager has to–

(a) Create an environment for every stakeholder to contribute his skills and knowledge in development of a project plan.

(b) Analyse needs of various stakeholders to ensure that they will be met in the best possible manner

(c) Analyse stakeholders’ risk tolerances to develop a risk management strategy.
**Main features and Advantages of ‘Matrix’ Type Organisation for Projects.**

In a matrix organization, the personnel are drawn from various departments to *assist* in project while continuing to perform their primary function. Thus, they are responsible to their functional superior as well as the project manager. This organisational structure thus allows dual line of command and subordination of personnel which is scoffed at in classical management literature which recommends Unity of Command. It has greater organizational complexity due to the dual reporting structure. Therefore, it needs certain level of organizational maturity to avoid conflicting situations that are inherently created by the structure.

Advantages of the matrix organizational structure for the projects are as under–

(a) Ensures effective utilization of organizational resources.

(b) Critical resources can be shared between projects.

(c) Cost in minimised due to utilisation of utilisation of in-house expertise and resources.

(d) Builds up specialised knowledge & technical base within the organization.

(e) Team morale & motivation remains at high level even at the project completion stage (it even peaks) as personnel are not uncertain about their future after project closure, hence focused.

(f) Authority and responsibility is shared and gives more time for team members to complex problem solving.

(g) It is an ideal form of organization for EPC companies.
Selection and Use of Software Packages for Project Management.

Project management software systems ease the process of putting the project plans together and then monitor and reschedule them as we progress. In order to select from a wide variety of software available in the market, it is necessary to understand our planning and monitoring needs and to decide the essential and desirable features. There are many packages available; more than 100; with different options. One should look at one’s needs because increase in options means increase in cost. Packages are available from Rs 10,000/- to 2,50,000/-, even up to Rs. 4,00,000/-. However, most of the time it is seen that the package are used to just 30% of their capacity.

Basic Features of the Project Management Software

(a) **Method** used is **Critical Path Method** with precedence diagramming (AON).

(b) **Relationships** used are – FS (Finish-Start), FF (Finish-Finish), SS (Start-Start), SF (Start-Finish) w. r. t. – leads / lags – normally defined in time units and percentage

(c) **Calendar** – it has to be defined. One has to define its own calendar and in it should define what is meant by 1 day specifically i.e. 1 working day or 8 hrs of a day etc. Similarly a week may be described as 5 days or 7 days, hence the project duration will depend on the calendar defined by you.

There is a requirement for different calendars because it may not be necessary that all the activities will adhere to a particular calendar, one of the reason can be because of multi – location project and each location following its own calendar. Or certain activities may follow a different calendar in the same location. In such cases location wise calendar has to be designed

**Types of calendars:**

- Project calendar
- Activity calendar (this will over write project calendar)
- Resource calendar – this depends on the no. of resources used, then one will have that many no. of calendars. Microsoft calendar does not have resource calendar.

(d) **Resource Allocation** – Facility to define and allocate active and passive resources and resource costs.

In Microsoft project package over 1000 resources can be defined. In Primavera one can defined 1 million activities for every project.

(e) **Work Breakdown Structure**– By ‘outlining’ tasks creating summary tasks
and sub tasks at different levels or by proper WBS.

(f) **Sub – Projects** – The facility of logically linking a task in one project to another task in another project.

(g) **Progress Updating** – One should be able to update on the progress of the project on a given day. This would tell us whether the project is getting delayed or will get delayed because it tells us the action to be taken for completing the project in time.

(h) **Costs** – The costs should be allocable to tasks as well as to resources. Cost codification could help work out summaries on various costing heads, budget actual comparisons and cash flow requirements. Capability to graphically represent cash flows or ‘Earned Value’ is desirable.

(i) Reports also can be generated using the packages, like activity schedules, cost reports, reports on activities to be carried for next 15 days.

(j) Interfacing is possible between organization date and project date to some extent.