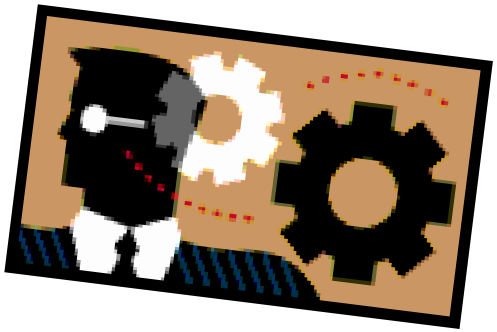
Project Management Practices
for Indian Space Vehicles



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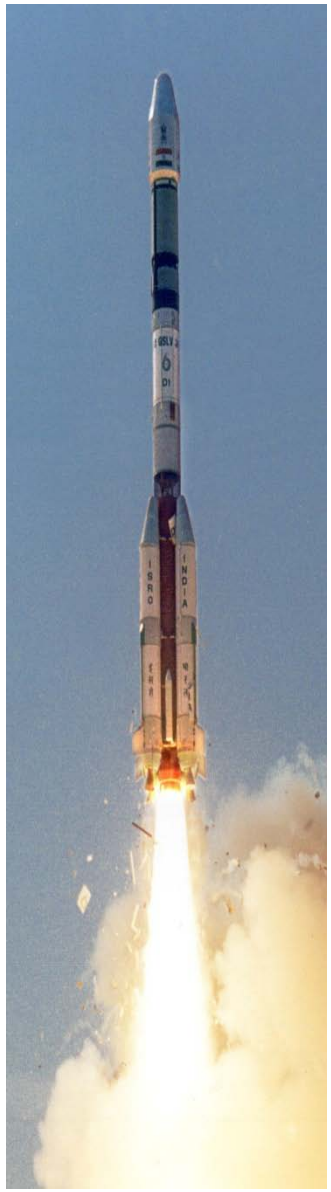
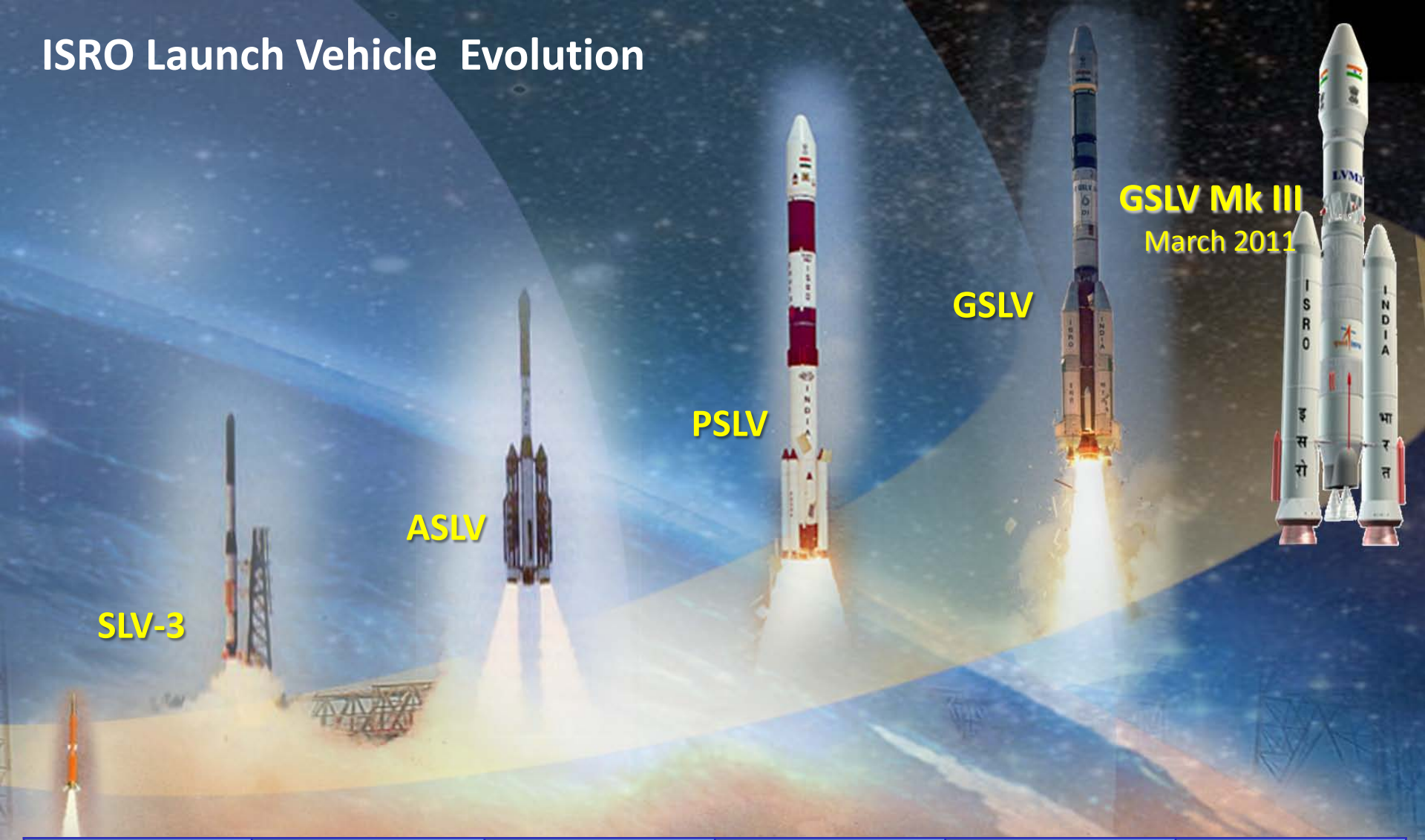


ISRO Launch Vehicle Evolution



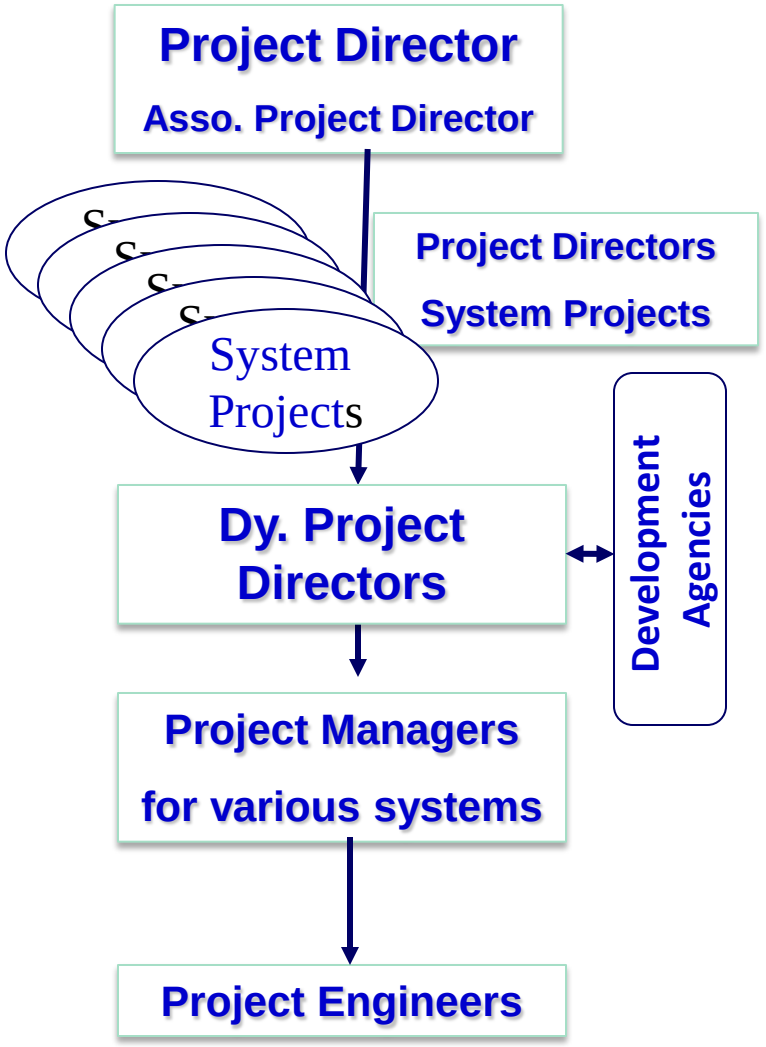
Launch Vehicle	SLV	ASLV	PSLV	GSLV	GSLV Mk III
Lift-off weight (kg)	17	40	295	450	635
Payload (kg)	40 (LEO)	150 (LEO)	1800 (SSO)	2200 (GTO)	4000 (GTO)

Management Structure

(For Launch Vehicle Programmes)

- A Core Project team with overall responsibility
- System Projects in new / critical areas
- Distributed work environment (work centers all over India)
- New technology development at ISRO units
- Large scale facility build-up
  - Launch complex, Propulsion systems development, testing, Avionics systems and Vehicle level testing & mock ups etc.
- Large scale industrial production
  - Motor cases, Light alloy structures & Propellant tanks Liquid / Cryo engine systems, Avionics system components, Propellants & chemicals, Sub assemblies integration etc.
- Implementation of change & configuration control

Matrix Management Structure



Core Project Responsibilities

Responsibilities of the Core Project have been :

- **Definition and implementation of project management plan & procedures.**
- **Communication of project objectives and plans to all levels**
- **Mission specification & interfaces with users.**
- **Launch complex and tracking network interfaces.**
- **Vehicle systems definition and specifications.**
- **Stage engineering and interfaces control.**
- **Vehicle / stage level configuration control & change management**
- **Direct monitoring of progress in all key areas**
- **Speedy execution without compromising performance and quality**
- **Programme management, cost/schedule monitoring and control.**
- **Organise project related reviews at micro and macro levels**

Programme Control Cycle

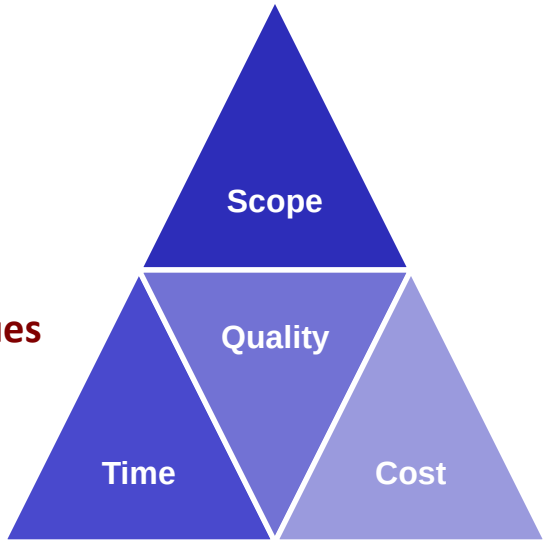
Used in Development

Establishing Targets	• Generated programme plans, system development plans, schedules & milestone plans.
Monitoring Performance	• Monitored through weekly biweekly and monthly review meetings, progress reports.
Programme Analysis	• Compared actual progress with expected performance.
Management Reporting	• Identified solution options, implemented decisions & follow up of needed actions.

Techno- Managerial Review Mechanisms

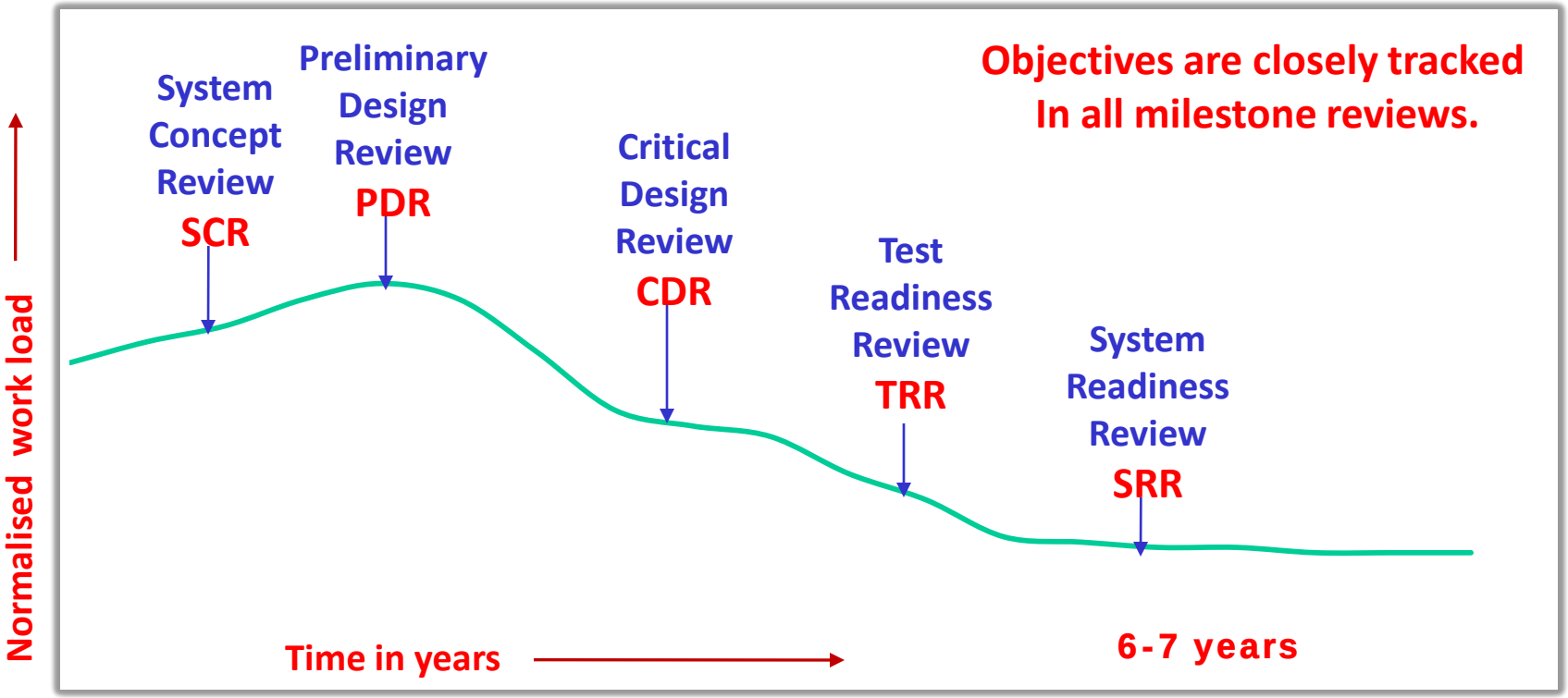
Management of Scope, Time & Cost without compromising Quality

- **Project Review Meetings**
  - Weekly review of project activity status
- **Project Executive Reviews (PEX) : Tier - 1**
  - Monthly reviews for resolving technical / managerial issues
- **Reviews by Centre Director**
  - Technical / managerial



- **Reviews by Project Management Boards (PMB) : Tier - 2**
  - General guidelines, budget approvals, schedules, facility & manpower
- **Reviews by Project Management Council (PMC) : Tier - 3**
  - Overall policy guidelines
- **Reviews by Chairman, ISRO**
  - Technical / managerial

Technical Review Milestones followed



Objectives

SCR

- ❑ System configuration.
- ❑ System /subsystem specs.
- ❑ Manufacturing & test facilities.
- ❑ Schedule & resource projections

PDR

- ❑ Technical adequacy of design approach
- ❑ Firm up specs. for system / subsystems
- ❑ Physical and functional interfaces definition.
- ❑ Clearance for detailed design.

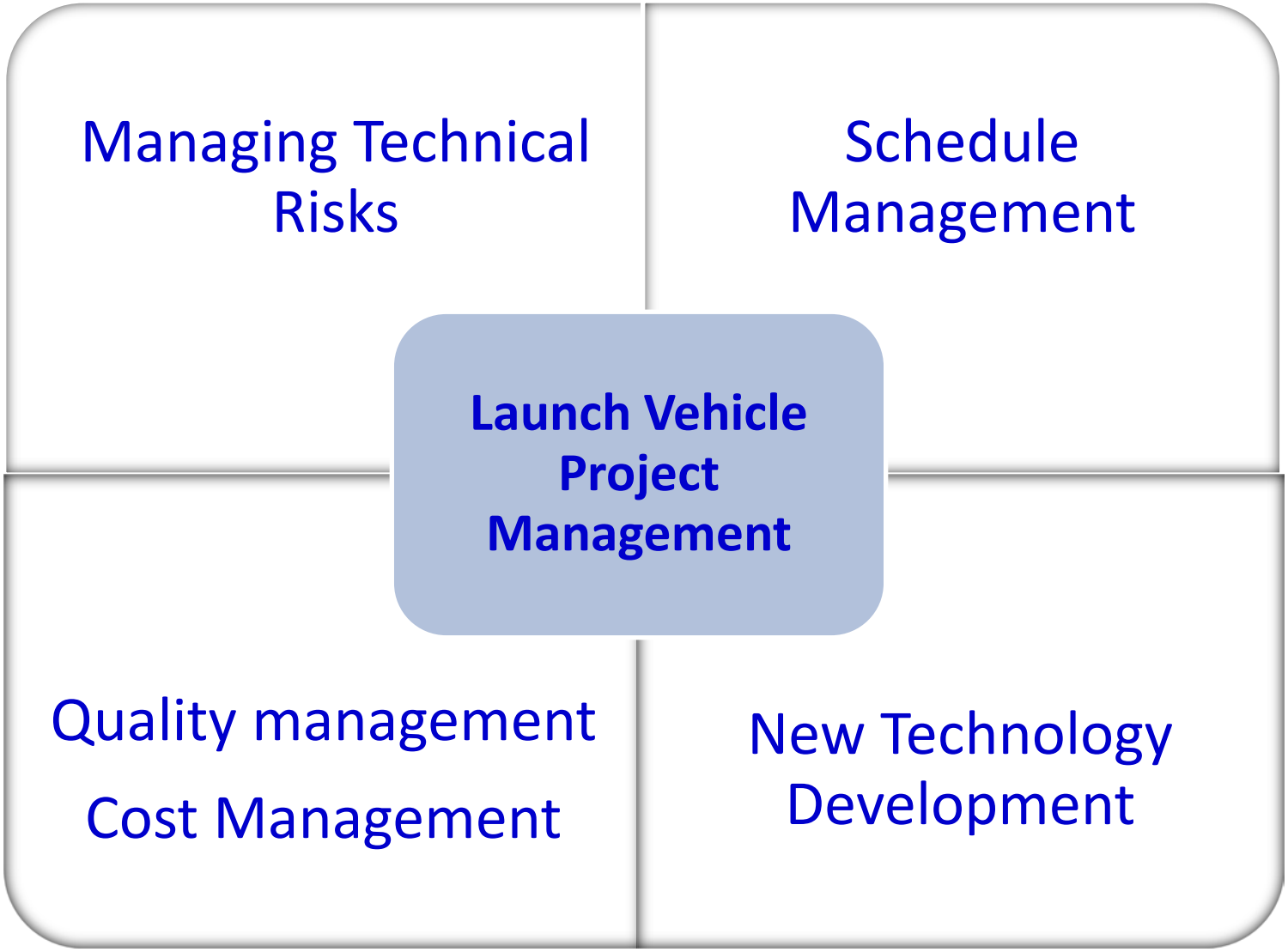
CDR

- ❑ Approval of specs. and design.
- ❑ Approval of baseline production
- ❑ Firm up interfaces
- ❑ Firm up detailed test plan

SRR

- ❑ Detailed interface performance checks.
- ❑ Certify system performance meets requirements
- ❑ Finalise system configuration
- ❑ Approval for system commissioning

Overall Management Approach



Managing Technical Risks

The following procedures are strictly implemented.

- ❑ **Identification of single point failure**
- ❑ **Redundancy management for mission critical Avionics / Control systems**
- ❑ **Vendor directory /Preferred part list**
- ❑ **Well evolved part screening for electronic components**
- ❑ **Process documents & QA / QC plans**
- ❑ **Test & evaluation at different levels**
- ❑ **Integrated system level checks**
- ❑ **Detailed simulations at different levels**
- ❑ **FMECA analysis /Fault tree analysis**

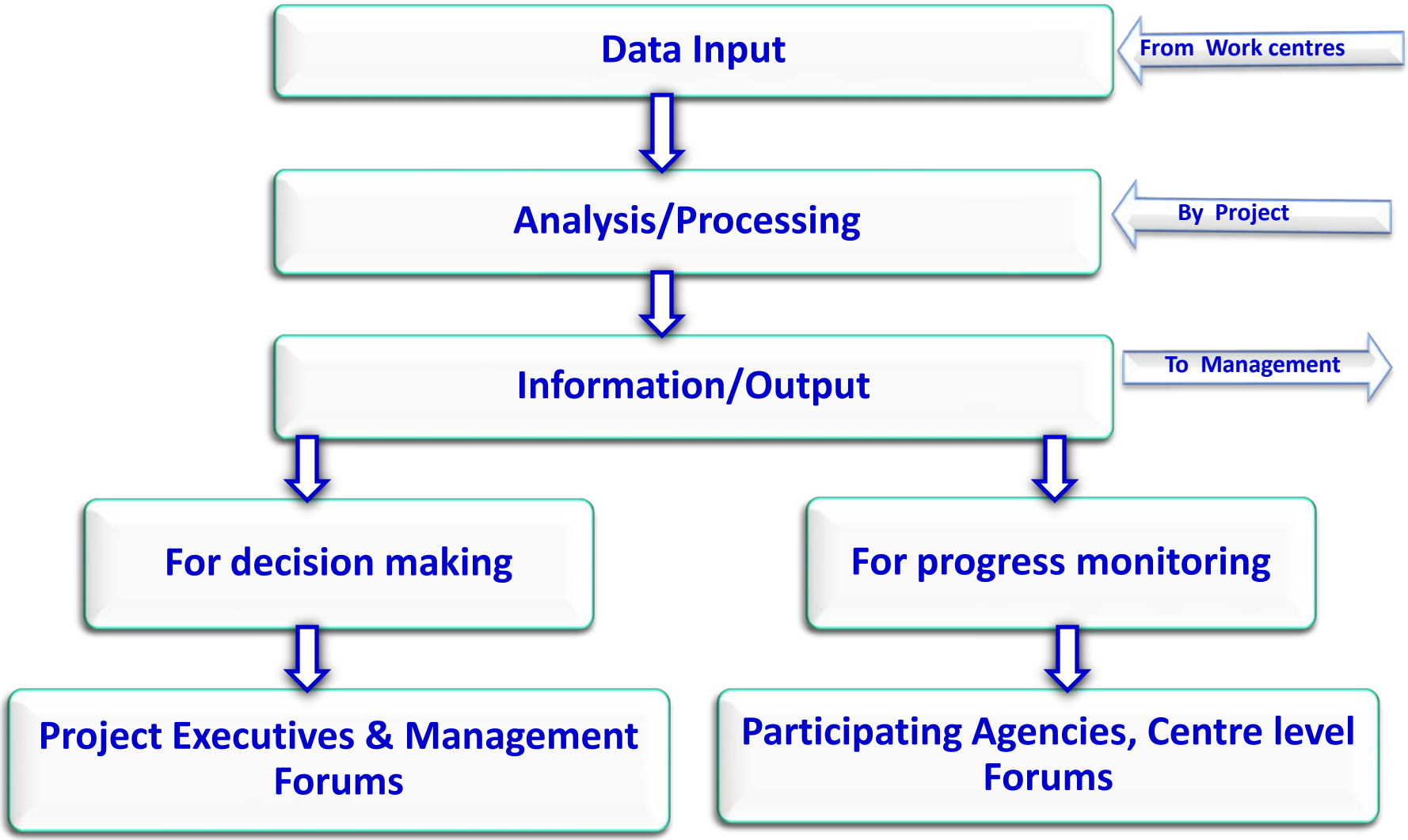
Project Schedule Management

- Optimal sharing of resources between numerous operational and development programmes
- The following methodologies are strictly implemented throughout the Project phase

Time management

- Work Break down Structures (WBS)
- Schedule analysis (PERT/CPM) & simulations
- Identifying 'limiting factors'
- Anticipating criticalities
- 'Feed forward' control– Real time correction of plans as work progresses, Work around plans
- Fast tracking through Concurrent Engineering approach
- Near critical paths & criticality index
- Integrated Information network for faster communication

Management Information System used



Quality Management

- Key processes and continuous Quality control during development and realisation of all launch vehicle subsytems are identified and carried out.
- The Strict Quality Assurance is ensured by meticulously following the various steps given below.
  - Approved specifications & design
  - Qualified materials, Process reviews
  - Inspection/Surveillance during production
  - Stage clearances
  - 3 tier non conformance management
  - Batch testing for VOQ, Acceptance testing

- The Quality Audit is given utmost importance
  - Using appropriate equipments
  - Reference Standards
  - Monitoring of key characteristics
  - Maintenance of records & traceability
  - Verification through audits

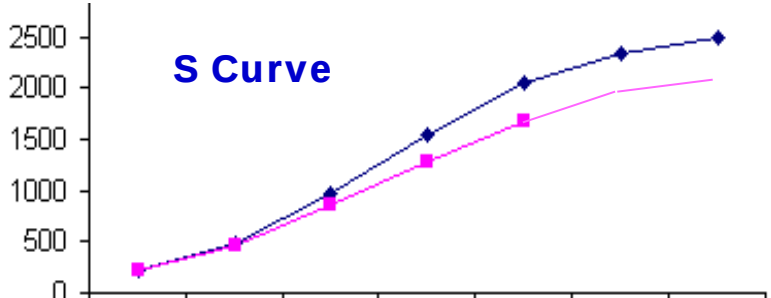
Project Cost Management

❑ Cost Estimation and Control

- ❑ The costs of the resources needed to complete project activities including infrastructure are worked out.
- ❑ More than 2000 line items with individual line item code for each launch vehicle project are identified to define the clear cut responsibilities
- ❑ Methodologies adopted for cost control
  - ➢ Maximal use of available technologies, proven designs
  - ➢ Planning for contingencies & cost escalations in the initial stage itself
  - ➢ Standardization & stock piling standard parts in the beginning
  - ➢ Design for manufacture (DFM) & concurrent engineering methodologies.
  - ➢ Taking calculated risks - Realization of subsystems in numbers based on confidence in design / analysis without waiting for test results
  - ➢ Optimal hardware rotation plan for different test programme
  - ➢ Optimal sequencing of number of tests & test durations
  - ➢ 'Make or buy' decisions with focus on 'comparative advantage'

❑ Expenditure Control Methodologies

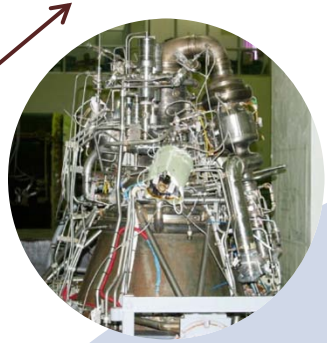
- ➢ Through Periodic management reviews
- ➢ Changes through department approved re-appropriation procedures & approval cycles
- ➢ S-Curve analysis for schedule/cost



	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Planned Exp.	216	486	976	1551	2046	2346	2498
Achieved Exp.	215.83	452.89	856.31	1274.33	1675.14		

BUDGET YEARS

Managing Technology Developments



Cryogenic technology development

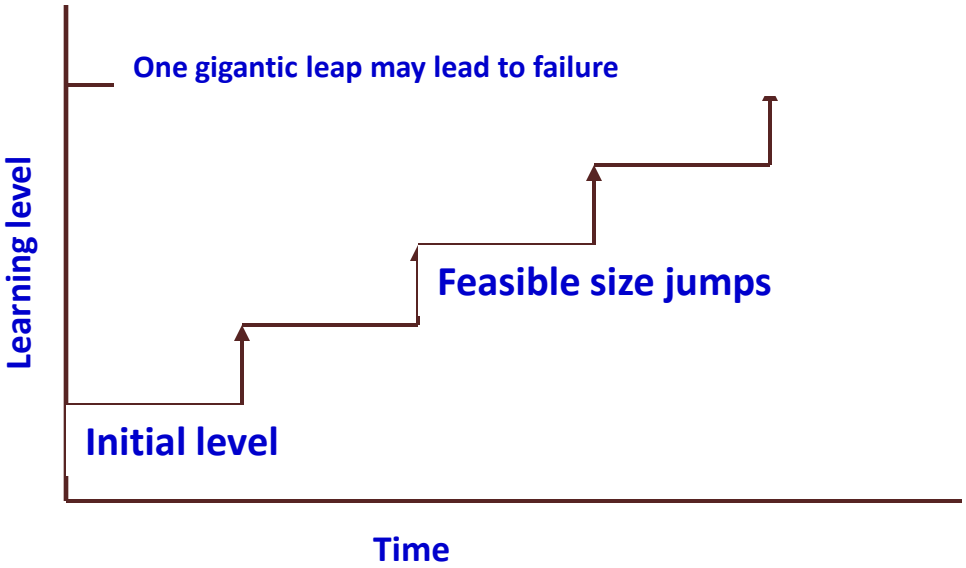
Larger engines in future

Indigenous 20 ton Cryo engine by 2010

Indigenous 7.5/ 9 ton Cryo engine (2008)

GK Cryo (Russian)

- Adopt available technologies or near term technologies
- Step by step approach for new technology development. Manageable learning steps.
- Identification of key improvement packages in terms of performance, reliability & cost & provide thrust for development
- Identification of key strategic areas for indigenization – e.g. Cryogenic technology strategic materials



Change Management

- Control of intersystem interfaces has been the major responsibility of the project team.
- The evolution and changes in the design are continuously monitored and the impacts assessed.
- Traceability of changes, decisions and inputs are utilised to assess the impacts of a new change.
- Design changes and requirements are closely monitored during development and changes are meticulously catalogued.
- Dissemination of the information across the system teams are done expeditiously using management information tools.
- Management of changes is given high priority to ensure the success of operational launches.

Launch Campaign Management

Integrated Team Effort

- Launch vehicle
- Space craft
- Propellant servicing / Safety
- Tracking & ground station
- Logistics

Campaign management system

- Mission Director
- Vehicle Director
- Satellite Director
- Range Director

Planning methodology

- Micro level scheduling on day to day & hourly basis
- Orchestrated effort for resource deployment
- More than 100 people involved per launch at different phases of time

Reviews

- Technical /progress reviews
- Stage clearances
- Authorization reviews for launch Mission Readiness Review, Launch Authorization Board

Countdown

45 to 60 days activity at Sriharikota

Conclusions. (Success through Team effort)

- The Management Structure which is in vogue has been very effective .
- The Programme Control Cycle and the Overall Management approach have been very efficient , leading to successful space launches.
- Indian Space ia able to implement programmes with shoe string budget through effective Schedule and Cost controls.
- Focus has always been on achievement of collective results.
- Time tested review mechanisms have helped to achieve technical excellence.
- Some of the key factors for the effective management of Indian Space Programme are:
  - Engaging the teams into productive, constructive discussions around ideas and issues
  - Accepting and committing to decisions & plan of actions arrived at by the team.
  - Each identified team member is accountable for delivery as per the decided plans.
  - Creative leadership, rewards and recognitions to the deserving team member/s who make significant contributions.