Manual for Implementation of ITS and MIS for Urban Bus System

15th November 2019

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AGENDA

- Structure Of the ITS / MIS Manual
- Chapter 1: Introduction to the Manual
- Chapter 2: Overview of ITS and MIS Projects
- Chapter 3: Planning an ITS / MIS Project
- Chapter 4: Design the ITS / MIS Project
- Chapter 5: Implementation and Evaluation of ITS / MIS Projects

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INTRODUCTION

ITS and MIS are important tools for public transport agencies

Many authorities have implemented ITS and MIS over last few years

However, ITS/MIS projects have met with limited success

Considering the importance of ITS and MIS, MoHUA, with the support of the World Bank, has taken an initiative to develop a manual for ITS and MIS

The ITS/MIS manual will serve as a guidance document for the public transport agencies in planning, designing, implementation and evaluation of ITS and MIS projects

Support to PT Agencies for better understanding of =>

- Basic characteristics of ITS and MIS, benefits and limitations
- Holistic planning for ITS and MIS in line with management and operations functions of urban bus services
- Laying down ITS and MIS systems requirements like data, information processing, Networks, communications, system architecture and reporting requirements
- •Analysis of possible business models for implementation of ITS/MIS Project.
- •Estimation of overall cost including implementation costs, O&M costs and in-house costs

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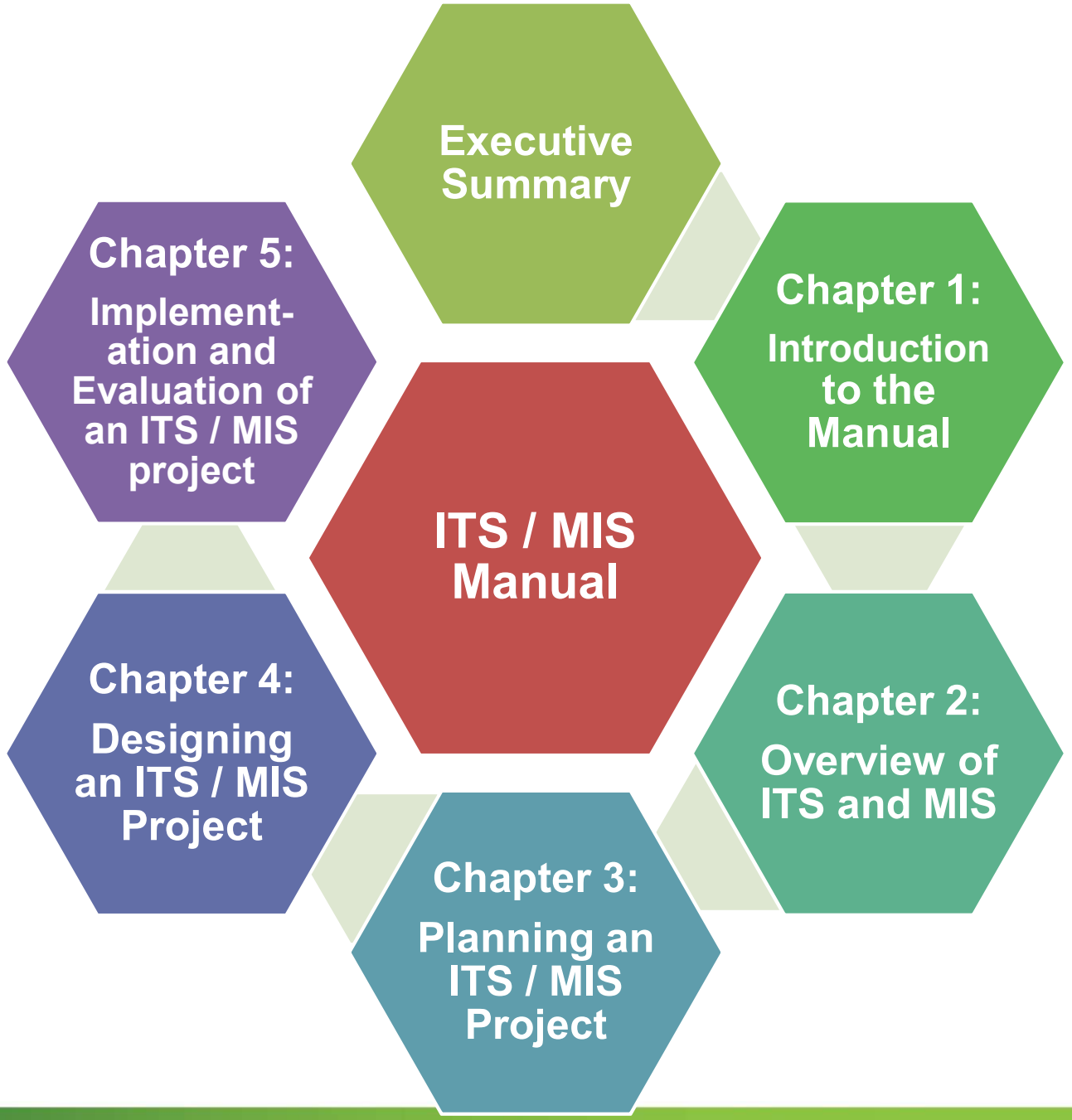
STRUCTURE OF THE ITS / MIS MANUAL



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Chapter 1: Introduction to the Manual

CHAPTER 1: INTRODUCTION TO THE MANUAL

1 Why ITS or MIS is Needed?

2 Purpose and Scope of the Manual

3 Target Audience

4 Guidance for Using the Manual

5 Reference Material, Credits and Acknowledgements

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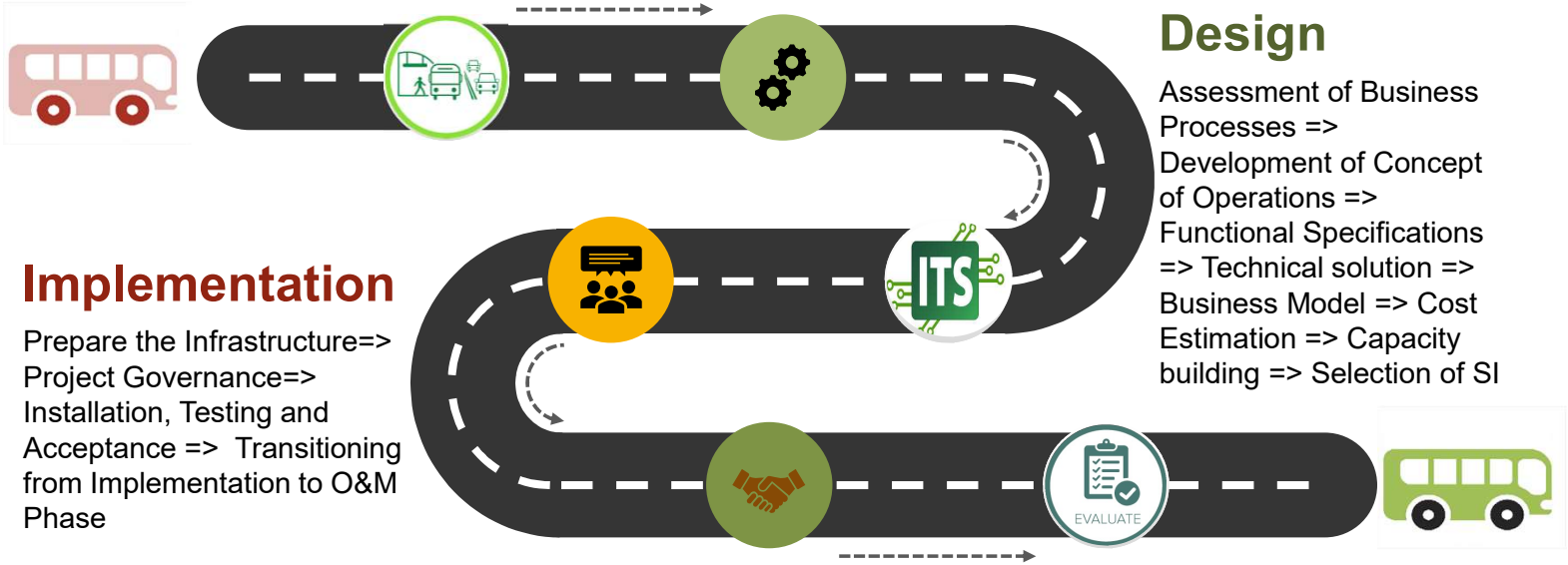
Purpose and Scope of the Manual

Purpose

To act as a guidance document for the entire lifecycle of ITS / MIS projects

Planning

Need Assessment => Stakeholder Engagement => Goals and Objectives => Functions and Services => Development of Scope => User requirements and Project Plan



Design

Assessment of Business Processes => Development of Concept of Operations => Functional Specifications => Technical solution => Business Model => Cost Estimation => Capacity building => Selection of SI

Implementation

Prepare the Infrastructure=> Project Governance=> Installation, Testing and Acceptance => Transitioning from Implementation to O&M Phase

Evaluation

Finalization of Performance Indicators=> Measurement of Performance Indicators Pre and Post Implementation=> Performance Analysis => Follow-up Action Plan

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Target Audience

Target Audiences

PT Agencies

Operators
(operating urban bus services including BRTS)

Consultants
(engaged in providing consulting services to PTAs and Operators)

Suppliers (Systems Integrators and suppliers involved in implementing ITS and MIS projects for urban bus services)

Levels of Users Targeted

- ***Chief Executives / Top Management***
- ***ITS/ICT/IT heads***
- ***Heads of other departments***
- ***Middle management officers***
- ***Other ITS/ICT/IT personnel***

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Chapter 2: Overview of ITS and MIS Projects

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CHAPTER 2: OVERVIEW OF ITS AND MIS

1 ITS Application Areas, Benefits of ITS

2 MIS and its Benefits

3 ITS / MIS Technology Framework

4 Generic Components of ITS / MIS

5 Case Studies of ITS / MIS

6 Limitations and Cautions of ITS and MIS

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Overview of ITS

Application Areas of ITS

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Overview of ITS

Technology Components of ITS

S.No	ITS Application Area	ITS Technologies	Devices
1	**Operations Management**	• Automatic Vehicle Location System • Automated Scheduling and Dispatch System • Vehicle Identification	• Vehicle Tracking Device • On-Board Integrated Controller Unit • RFID Devices • Driver Management Console
3	**Passenger Information System**	• In-vehicle Display Units • At-Station Display Units • Web-based Passenger Information System • Mobile App based Passenger Information System	• LED / LCD displays in Buses • LED /LCD displays at bus stations/bus stop • Mobile devices • Passenger Announcement Devices
2	**Fare Collection System**	• Fare Media (Paper-based tickets, smart cards and mobile device based tickets) • Devices to read/write media • Back-office systems • Depot / Station ICT equipment and infrastructure. • Central Clearing House	• Electronic Ticketing Machines • Smart Card Validators • Ticket Vending Machines • Smart Card Issuance Terminals • Card Personalization Devices • Fare Gate (in case of BRTS)
4	**Security System**	• In-Bus surveillance • At-Station surveillance • At-Depot surveillance	• In-bus and at-station CCTV Cameras. • At-Depot CCTV cameras. • Digital Video Recorder • Storage of video feed at Data Center

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Overview of MIS

Financial Performance Indicators

Operational Cost

- Personnel Cost
- Material Cost
- Operating Cost Per Effective Kilometer (CPKM)

Revenue

- Traffic Revenue
- Non-Traffic Revenue
- Subsidy re-imbursement
- Fare concessions re-imbursement
- Total earnings per bus per day or per km

Performance Ratios

- Total Cost per bus per day (on road)
- Percentage return on capital invested
- Schedules earning more than total cost
- Schedules with earnings higher than variable cost but lower than total cost
- Schedules earning less than variable cost
- Operating cost per passenger km

Operational Performance Indicators

Capacity

- Fleet Size
- Buses on-Road
- Buses off-Road
- Bus Utilization per day
- Staff ratio per bus

Serviceability

- Scheduled kms vs Effective kms
- Effective kms vs cancelled kms
- Total Passenger kms
- Load factor per bus / per route
- Passengers carried per bus per day

Reliability

- Trips scheduled vs Trips cancelled
- Regularity and punctuality
- Adherence to operational discipline (rash driving, stops skipping, route deviations, crew behaviour)
- Breakdowns recorded for every 10,000 kms

Safety

- Accidents recorded per 100,000 kms
- Number of fatal accidents recorded
- Number of non fatal accidents recorded
- Number of complaints received from passengers on crew behaviour, rash driving, stops skipping, route deviations

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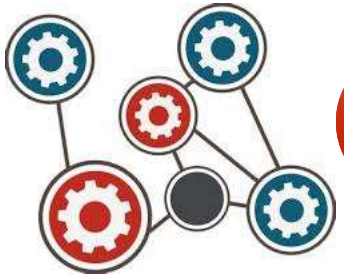
ITS / MIS Technology Framework



System Architecture

Communication Architecture

ITS / MIS TECHNOLOGY FRAMEWORK

Data Models

Integration

Standards

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Generic Components of ITS / MIS

Field Devices (Vehicle Tracking Device, CAN, CCTV, Electronic Ticketing Machines, Fare validators, fare gates, passenger information display units, etc.)

Command and Control Centre or Operations Control Centre

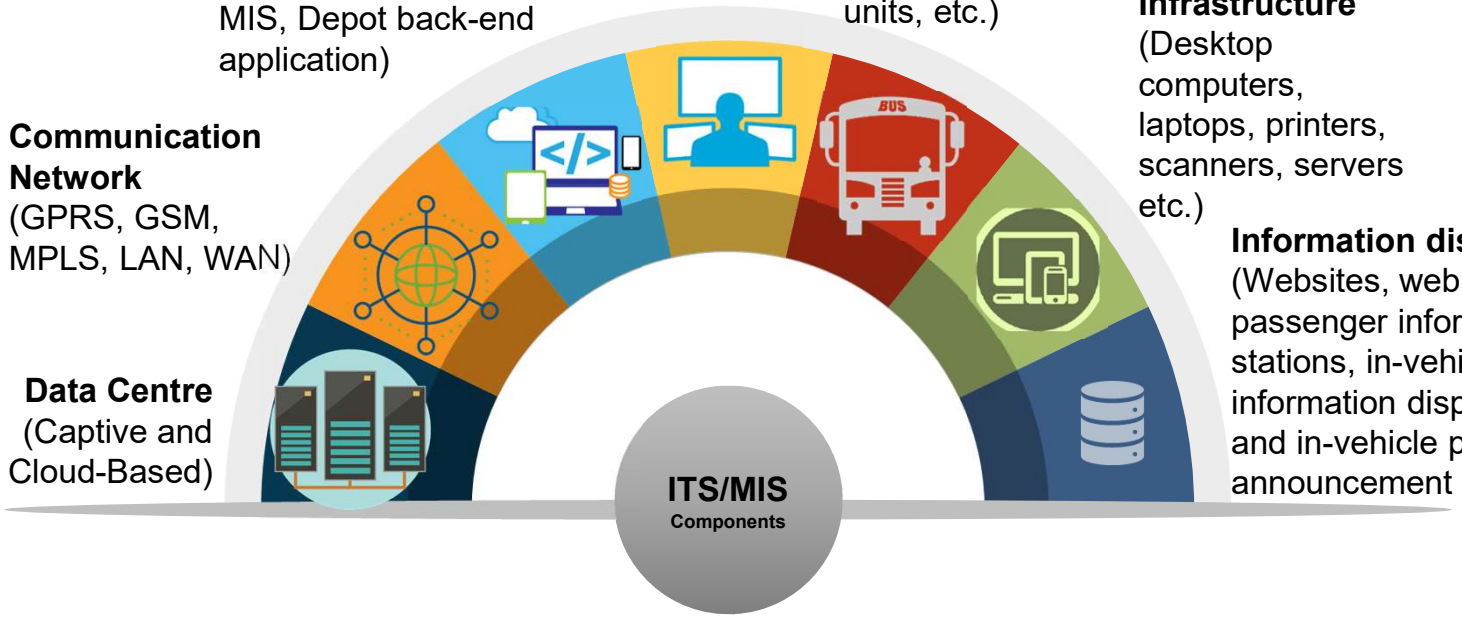
Application Software (AVLS, AFCS, PIS, MIS, Depot back-end application)

ICT Infrastructure (Desktop computers, laptops, printers, scanners, servers etc.)

Communication Network (GPRS, GSM, MPLS, LAN, WAN)

Information dissemination channels (Websites, web portals, mobile apps, passenger information display at stations, in-vehicle passenger information display units, at the station and in-vehicle passenger announcement systems etc.)

Data Centre (Captive and Cloud-Based)



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Case Studies of ITS / MIS

- ITS / MIS implementation in selected cities in India
- Summary of ITS / MIS applications implemented
- Challenges faced and overcome in implementing ITS / MIS
- Impact of ITS / MIS
- Key Lessons Learnt

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Key Lessons Learnt

	PROJECT PHASE	KEY LEARNINGS
1	**Project Conceptualization and Design**	• Lack of in-house capacity to understand and conceptualize ITS/ MIS Project • Challenges in drafting requirements – 'one size fits all' approach • Lack of availability of proper documented guidelines for planning and implementing ITS initiatives for Indian cities
2	**Project Procurement**	• Difficulty in attracting good SIs – High risk, ambiguity in scope, PQ conditions not in line with project scope/ value, stringent SLAs • Long and drawn out bidding process with multiple iterations
3	**Project Implementation**	• Lack of in-house capacity to review/approve deliverables • Ambiguity in scope leads to change requests/ disputes • Lack of readiness on part of authority – site, buses, power, users etc. • Acceptance criteria not clearly laid down • Resistance to change at various levels of the organization • Instance of sabotages to ITS equipment installed on buses • Lack of experience on part of the SI in implementing ITS projects for large fleet size • Long duration to achieve stabilization of the ITS initiatives
4	**Operations and Maintenance**	• Vendor lock-in and inability to scale up beyond the terms agreed in the RFP • Inadequate support provided by the SI during the maintenance • Integration with 3rd party/external systems

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Limitations and Cautions of ITS / MIS

- ITS/ MIS are not a single-stop solutions to the issues faced by PT Agencies. They need to be supported with right processes/people and effective use of the system
- PT agencies need to identify the goals for the proposed ITS/MIS project carefully
- PT Agency should ensure that unnecessary expectations on benefits from ITS/MIS are not built up
- Co-operation and willingness on part of the different stakeholders to use the ITS / MIS is the most critical aspect for it to succeed
- There is a possibility that the PT Agencies may face resistance to change on part of the users of the system
- ITS/MIS is not a means to make up for the poorly managed and organized public transport systems
- ITS / MIS initiatives need financial commitment, both for implementation as well as for O&M

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Chapter 3: Planning an ITS / MIS Project

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Overview of Planning an ITS / MIS Project

1. Need Assessment
2. Stakeholder Identification
3. Setting of Goals and Objectives
4. Identification of Functions and Services
5. Identification of Users of ITS / MIS
6. User Requirements Preparation
7. Development of Scope of ITS / MIS Project
8. Preparation of Project Plan

WORKING NOTES AND HIGH LEVEL COST ESTIMATES

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Need Assessment for ITS / MIS

5. Are there reasons external to the PT Agency requiring adoption of ITS / MIS?

- Compliance to new regulatory requirements/ other external needs (NCMC, AIS140 etc.)

3. Can the issues be resolved without implementing ITS / MIS?

- ITS / MIS may not be needed to resolve administration related issues.

4. What are the envisaged benefits of ITS /MIS?

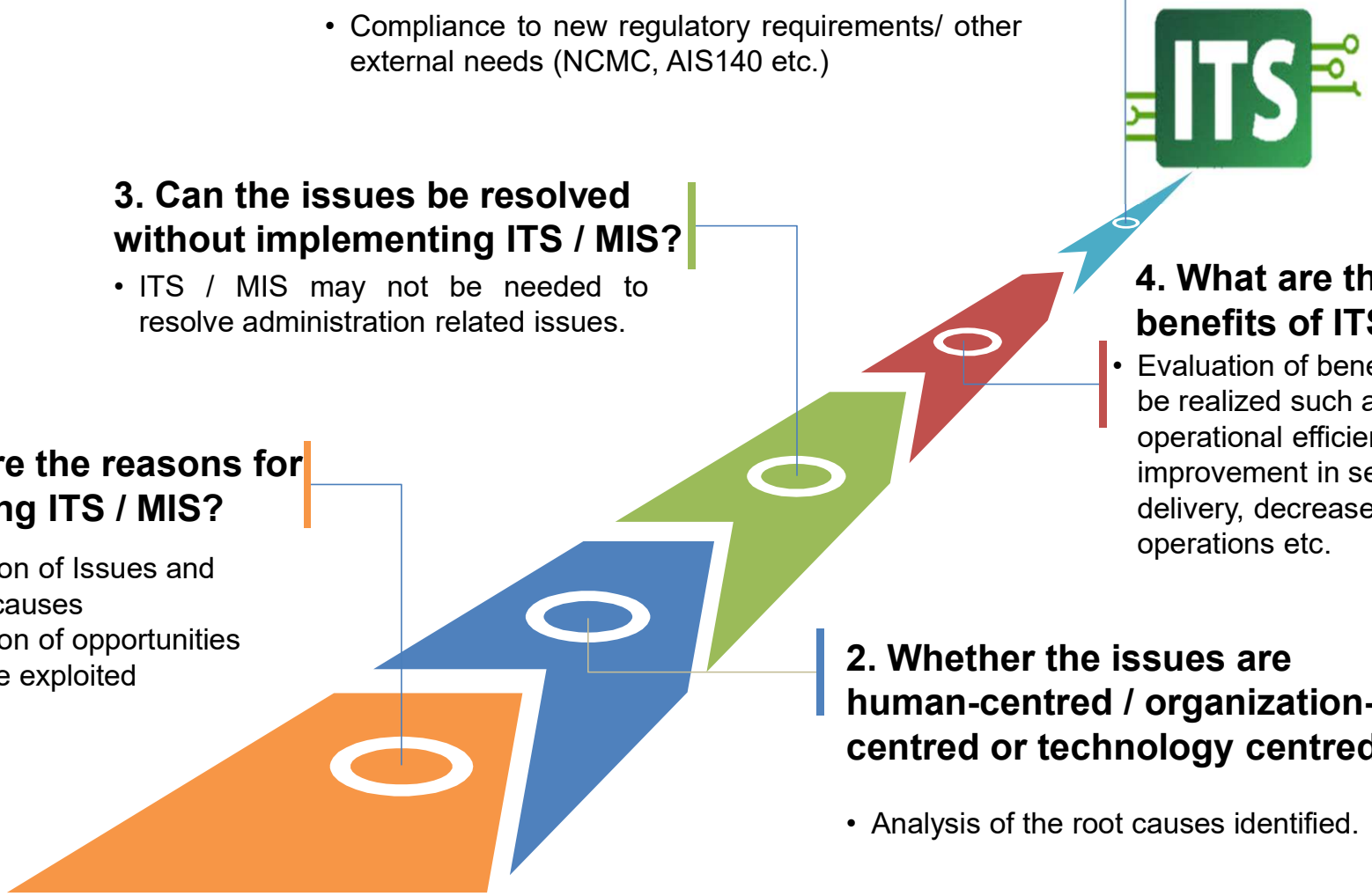
- Evaluation of benefits that can be realized such as increase in operational efficiency, improvement in service delivery, decrease in cost of operations etc.

1. What are the reasons for considering ITS / MIS?

- Identification of Issues and their root causes
- Identification of opportunities that can be exploited

2. Whether the issues are human-centred / organization-centred or technology centred?

- Analysis of the root causes identified.



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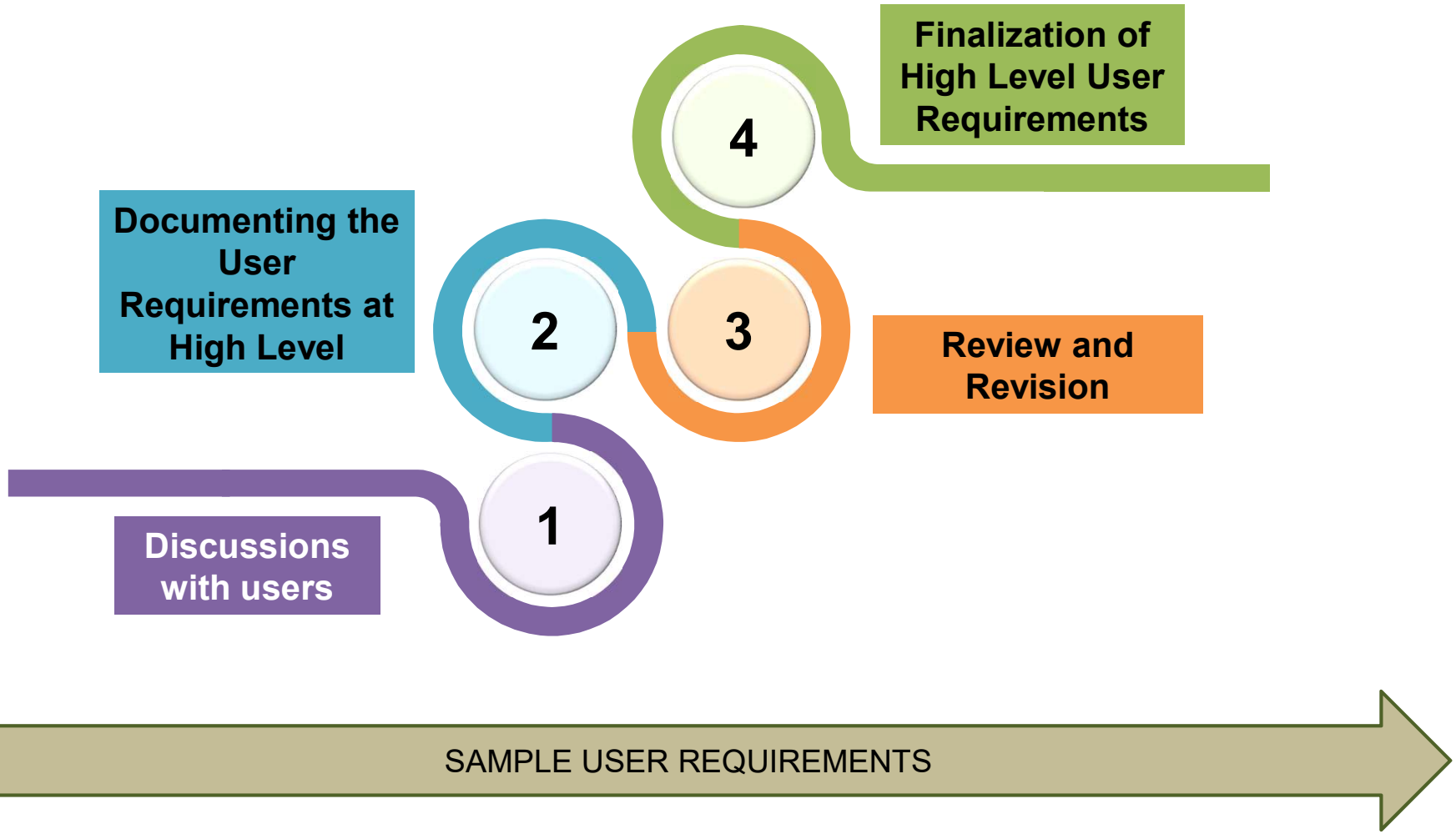
Finalization of User Requirements



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Development of Scope of ITS / MIS Project

1. Identification of ITS / MIS technologies in accordance with application areas

2. Identification of ITS / MIS project expectations and acceptance criteria

3. Identification of constraints for implementing ITS / MIS project

4. ITS / MIS project scope description

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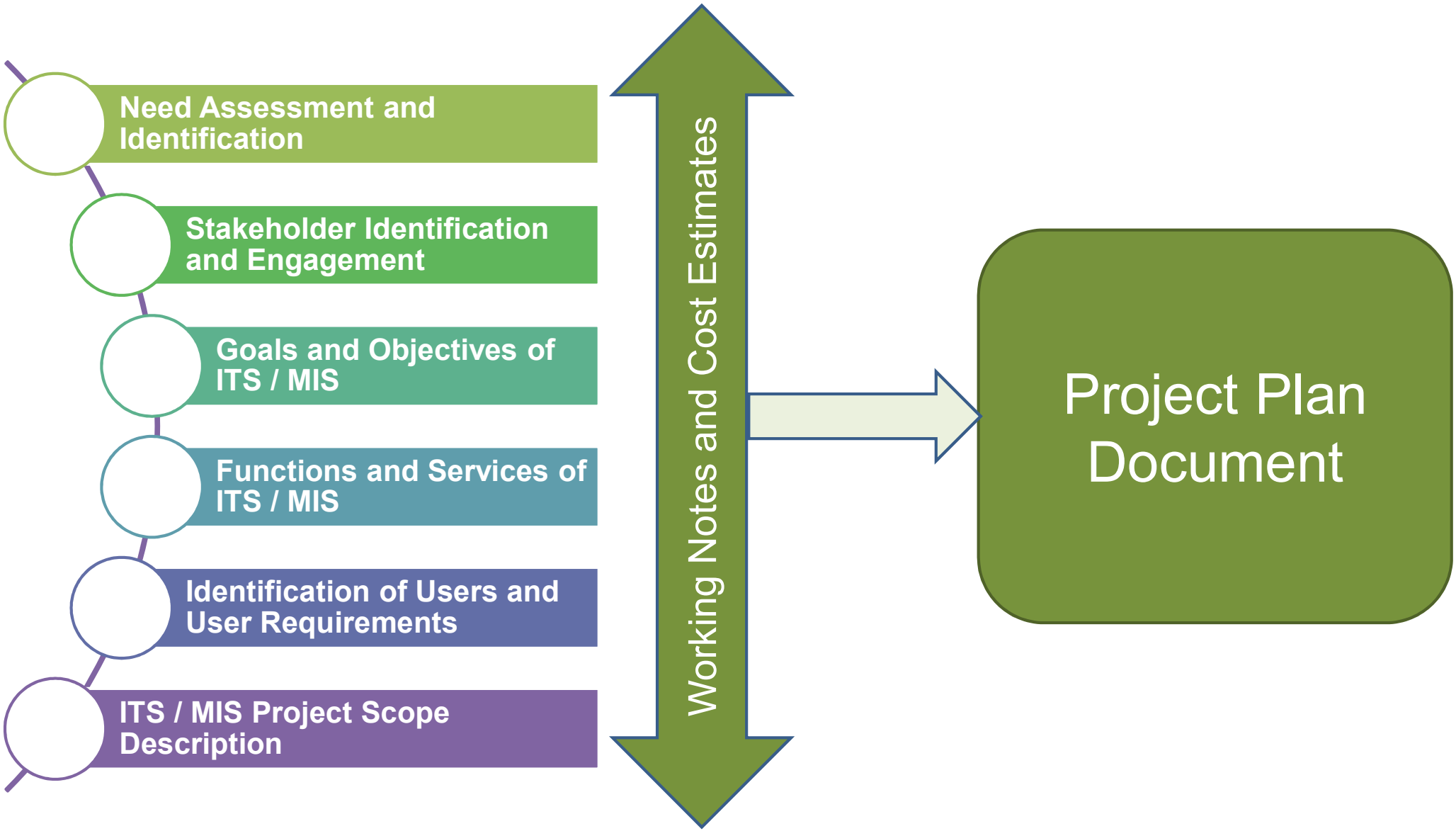
Preparation of Project Plan



A Project Management Consultant may be hired at any stage of ITS/MIS Project Planning/ Designing/ Implementation

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Chapter 4: Design the ITS / MIS Project

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Overview of Designing ITS / MIS Project

1. Assessment of Business Processes
2. Developing Concept of Operations
3. Preparation of Functional Requirements Specifications
4. Defining Technical Solution
5. Capacity Gap Assessment
6. Identification of Business Model
7. Estimation of Cost of ITS / MIS Project
8. Risk Identification and Mitigation Strategy
9. Selection of Systems Integrator

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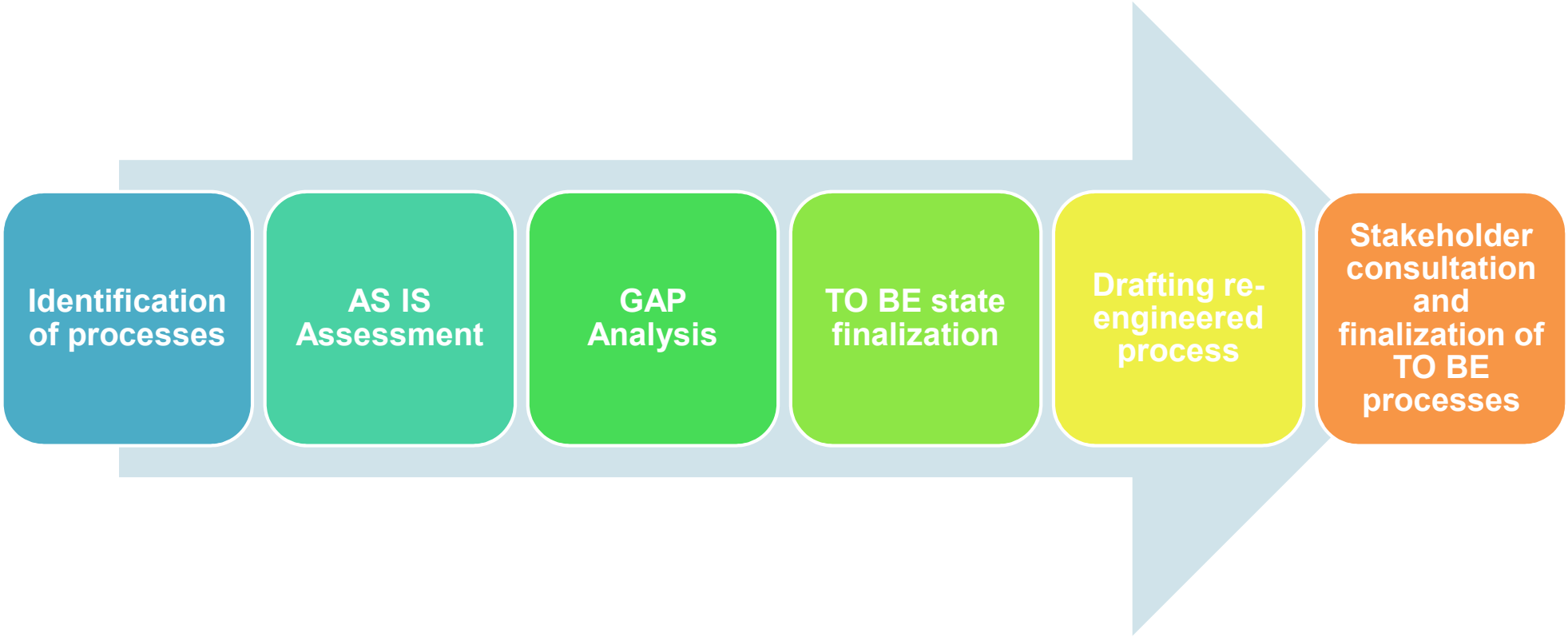
Assessment of Business Processes



ITS/MIS Project offers an opportunity to look into and change the business processes

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Development of Concept of Operations

CONCEPT OF OPERATIONS DOCUMENT

- Preparation of the Concept of Operations document - how tasks will be achieved by a combination of personnel, technology, organizational structure and processes
- Will be the base document for preparing the functional specfications

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Preparation of Functional Specifications

1 Necessary

Should include only those aspects that are deemed necessary in the ITS / MIS system.

2 Concise

Should be easily understood by all the intended users of the document. Each requirement should ideally be a single statement.

3 Attainable

The requirements should be achievable.

4 Complete

Each specification drafted should be a stand-alone statement that gives the reader a complete picture of what is required to be done.

5 Consistent

Functional Specifications should not contradict each other and should not duplicate other requirements.

6 Unambiguous

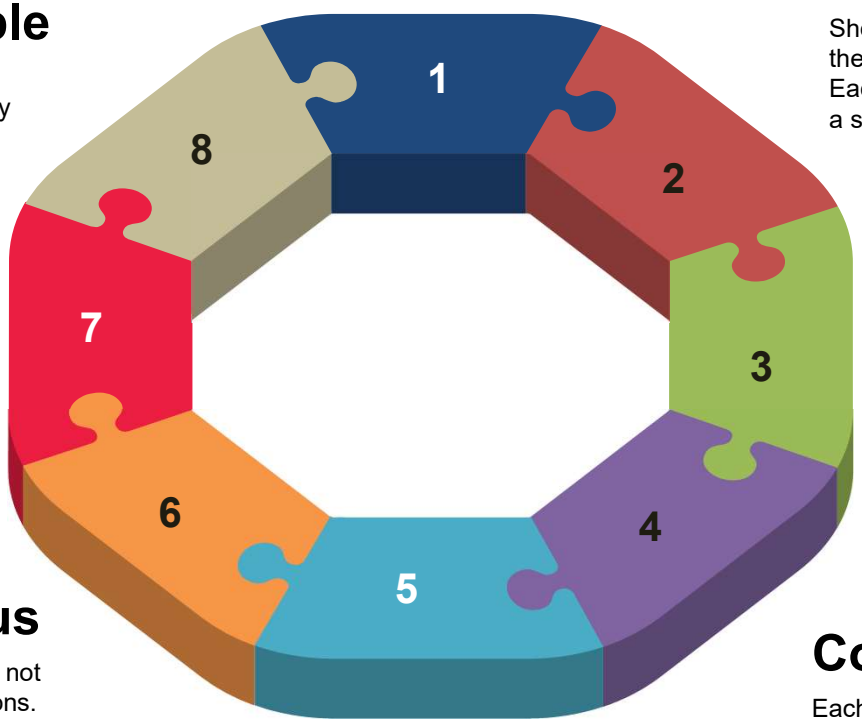
Functional Specifications should not be open for different interpretations.

7 Verifiable

Functional Specificatons should be verifiable Testing, Inspection, Demonstration or Analysis.

8 Traceable

Should be traced to the base requirement. Should be uniquely numbered



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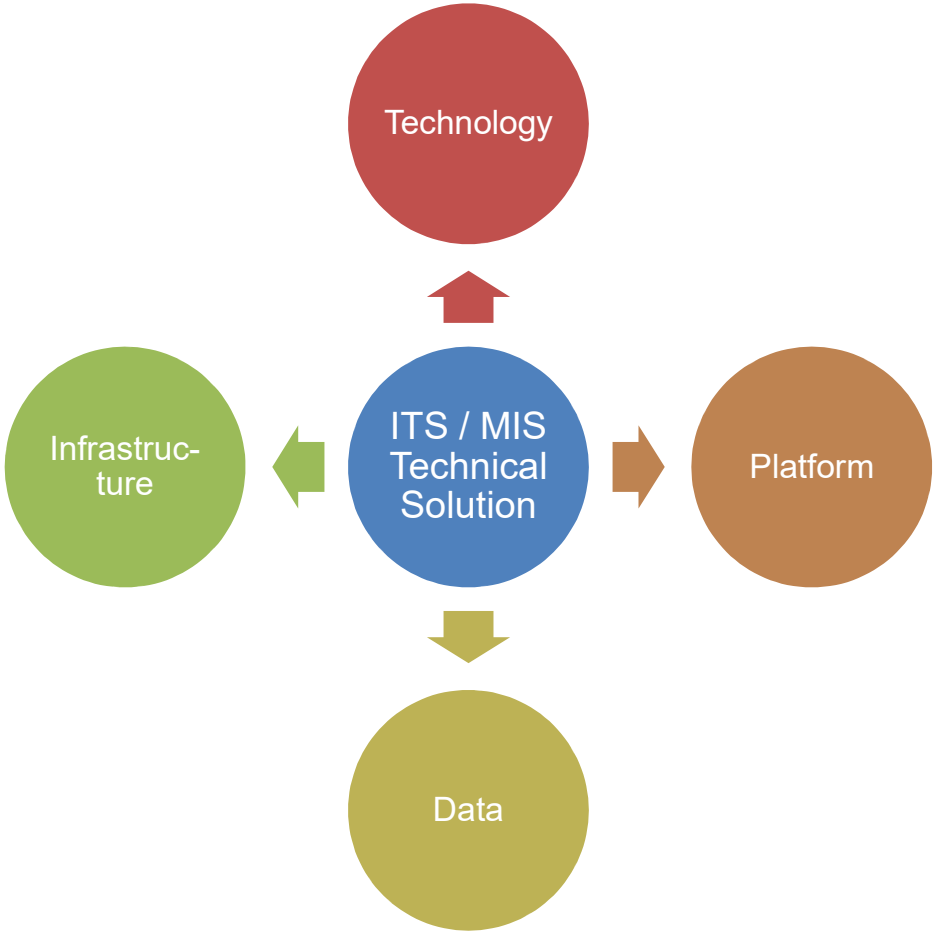
Defining the Technical Solution

Importance of identifying appropriate technical solution

Decision on advanced technical solution or a low cost solution that meets requirements

Defining the solution with interoperability and scalability requirements



Cost

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Identification of Business Model

- Build, Operate and Transfer (BOT) and its variants
- ITS as a Service
- Capex-Opex

Selection Criteria for Business Model

- ✓ Scale and Complexity of ITS/ MIS Project
- ✓ Availability funding for the ITS / MIS project
- ✓ Capacity on part of PT Agency to manage the ITS / MIS project
- ✓ Risk distribution and ability of the PT Agency to bear the project risks

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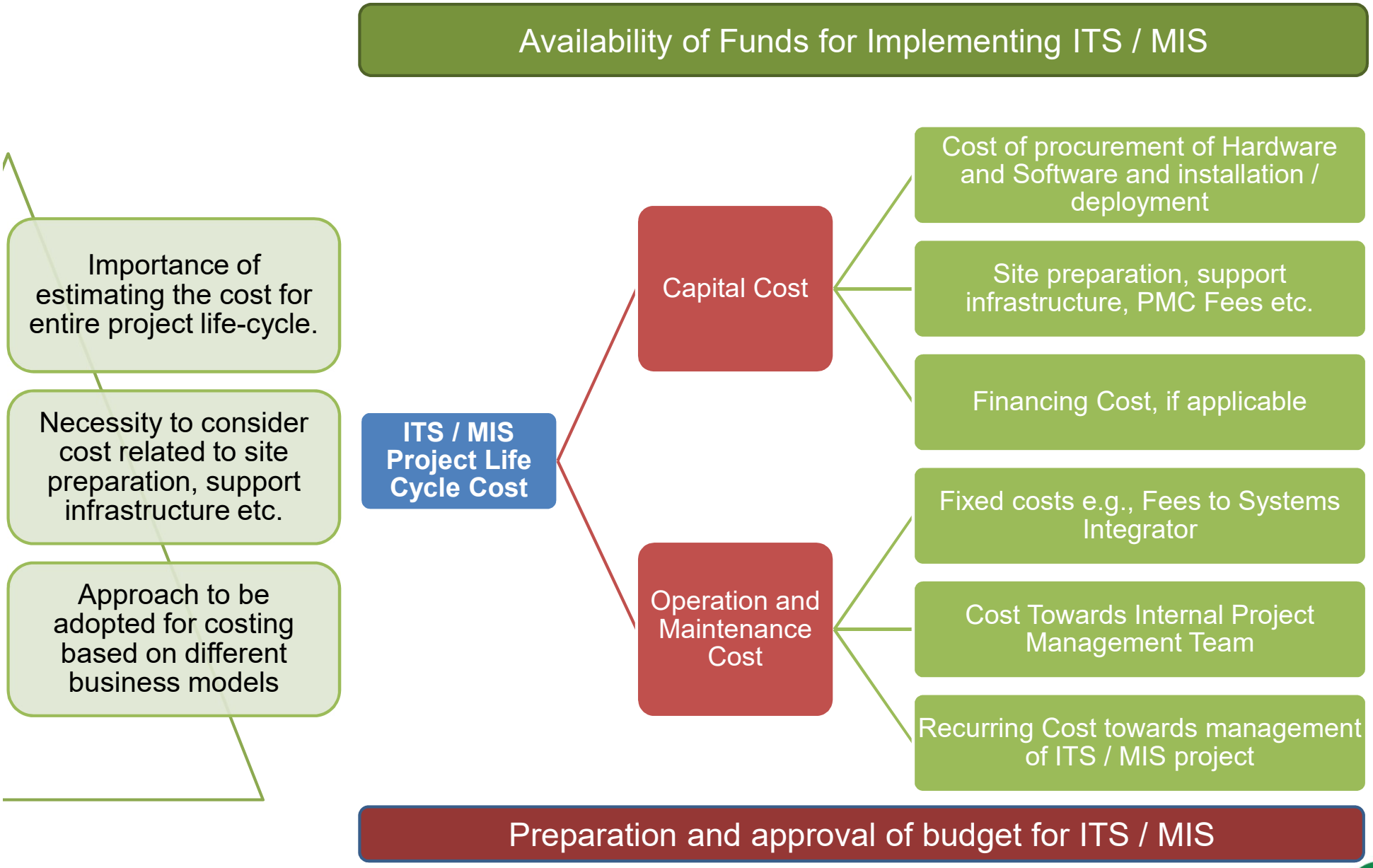
Preparing Cost Estimates



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DPR and Selection of Systems Integrator

Consolidation of output from Design Stage in a DPR

Model Request For Proposals (RFPs)
- Capex-Opex Model
- BOT Model
- ITS-as-a-Service Model

Guidance on choosing Domestic Competitive Bidding vs. International Competitive Bidding

Guidance note on preparing:
- Pre-qualification criteria
- Technical evaluation and qualification criteria
- Technical evaluation methodology (Least Cost Selection, QCBS)

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Chapter 5: Implementation and Evaluation of ITS / MIS Projects

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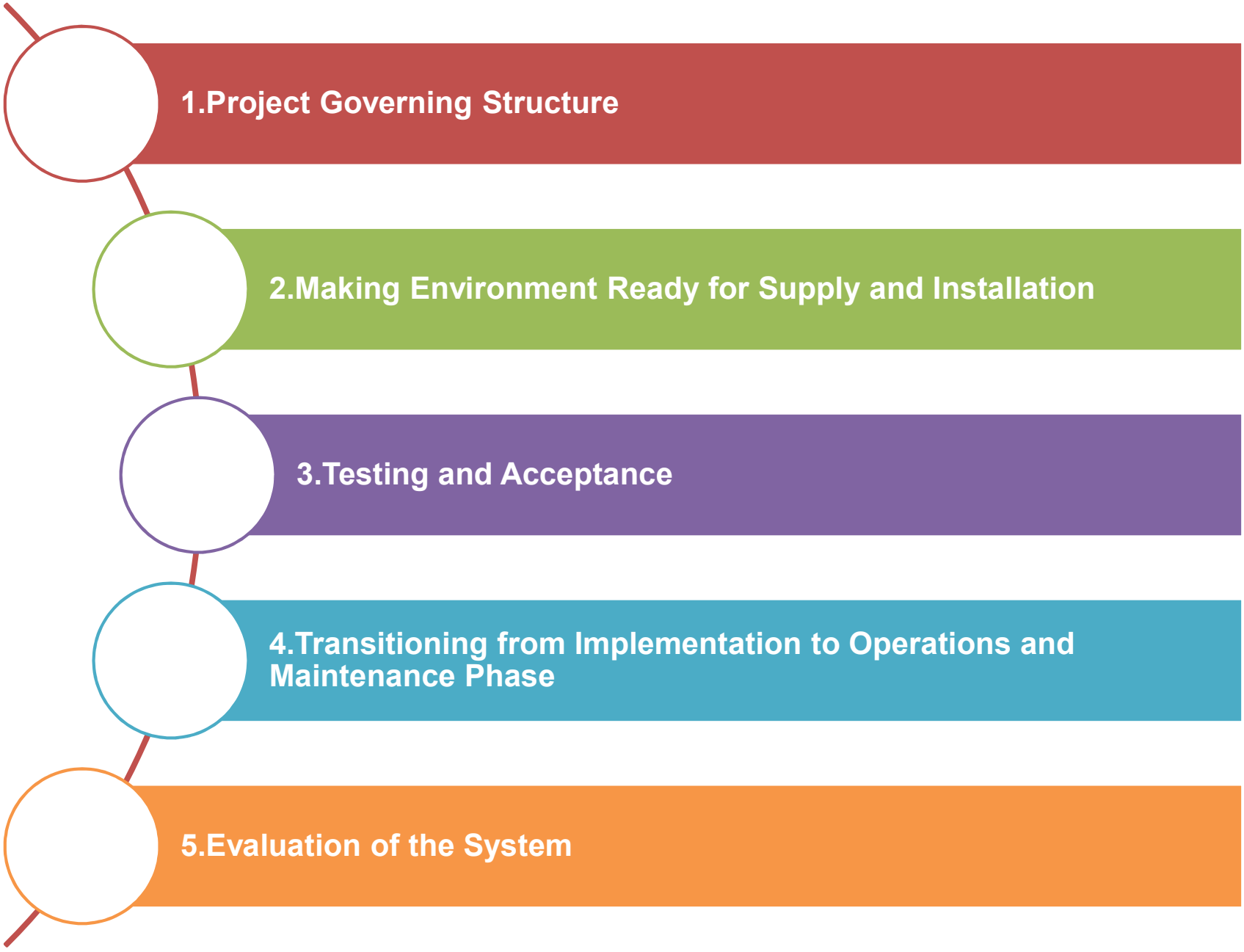
Implementation and Evaluation of ITS / MIS Project



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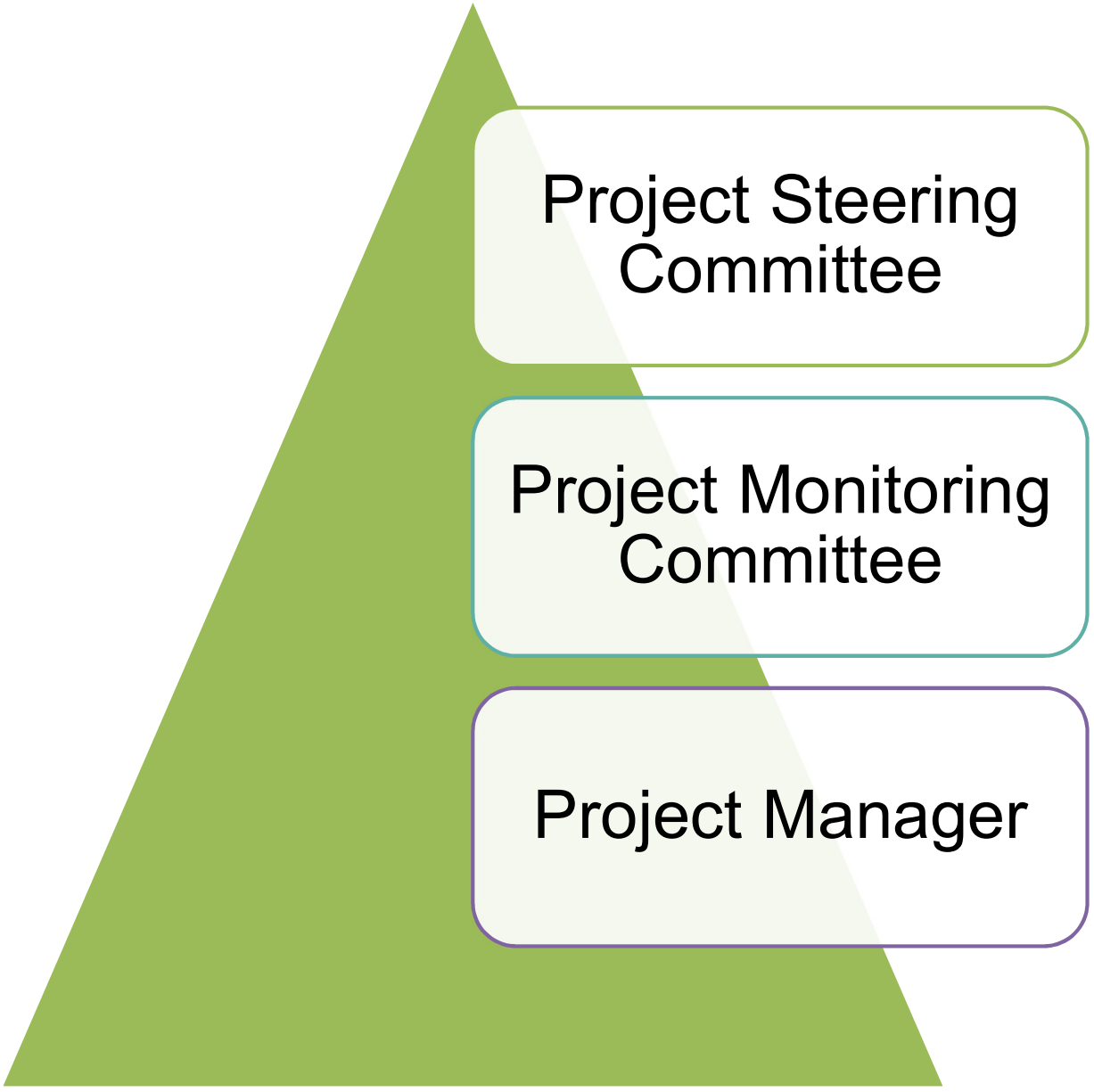
Project Governing Structure



- Composition of the Project Steering Committee and Project Monitoring Committee
- Role and Responsibilities of the committees and Project Manager in Project Governance
- Stage at which the committees have to be constituted
- All stakeholders to be involved in Project Governance

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Making the Environment Ready

Environment

- Site for Command and Control Center.
- Site for setting up Data Center.
- Site for setting up Disaster Recovery Centre.
- Bus Terminals / Bus Stations, Depots, Workshops, etc.
- Availability of Buses
- Electricity and back-up
- Identification of Users for training

Aspects to be considered

- Non-availability of adequate physical space.
- Captive Data Center vs. Cloud Based.
- Ownership of Bus Stops / Bus Terminals.
- Availability of buses in adequate condition for installation of ITS equipments.
- Availability of staff to be trained on ITS / MIS without affecting the day to day operations.

Risks associated with not getting the environment ready in time

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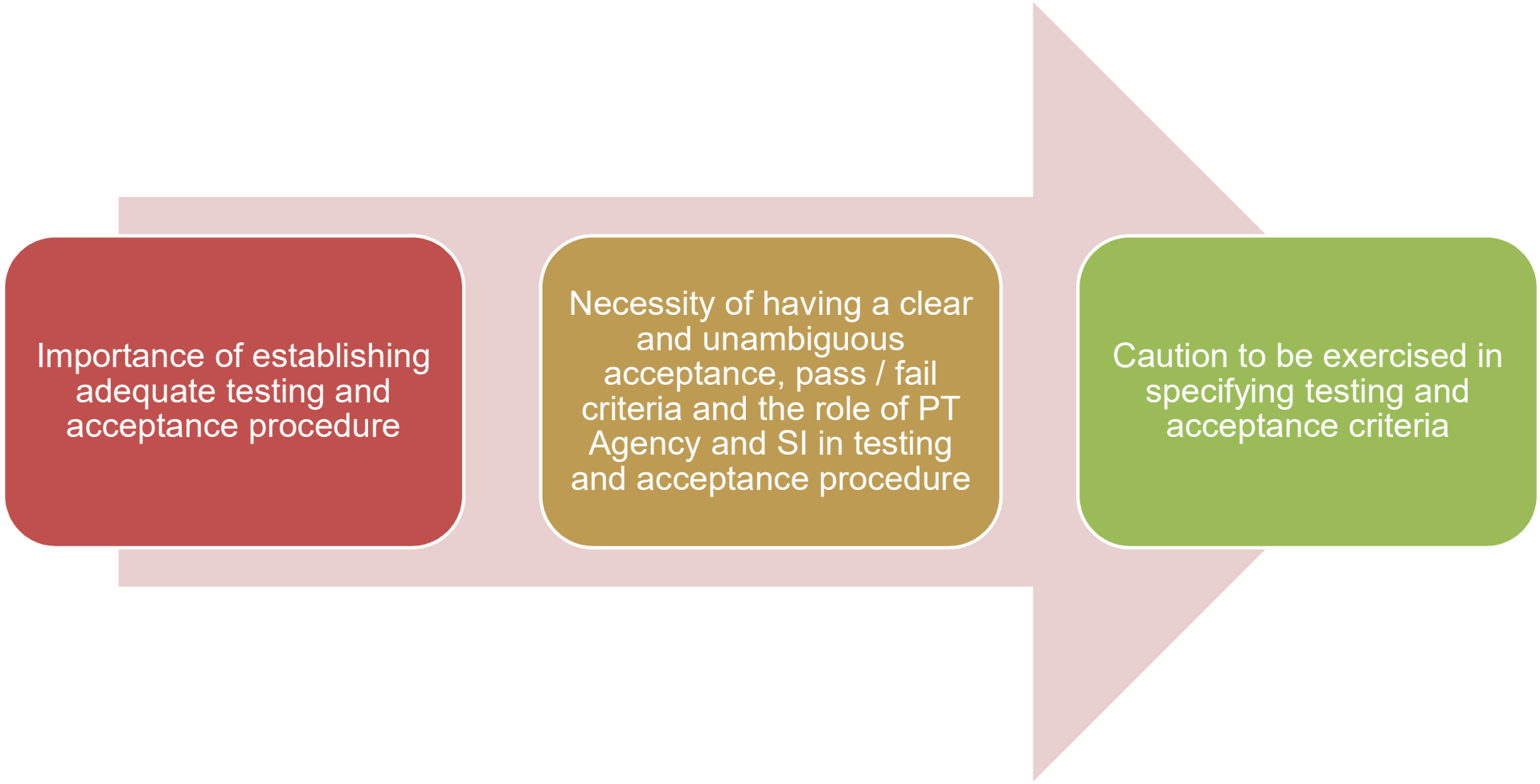
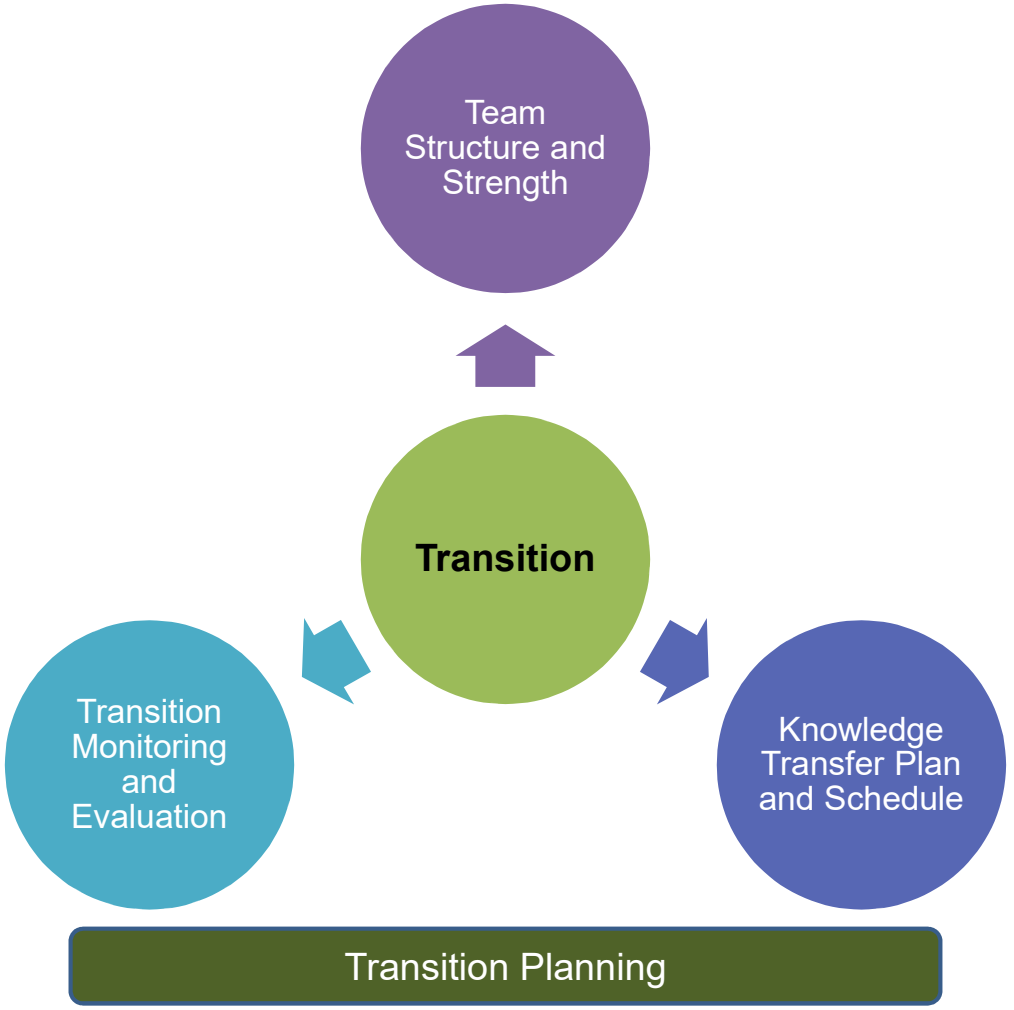
Testing and Acceptance



Transitioning from Implementation to O&M Phase

Implementation to O&M → **O&M to SI Exit**

- Why planning for transition from implementation to O&M Phase and take-over from SI is important?
- What aspects should be considered under transition process?
- How should transition be managed for an ITS / MIS project?



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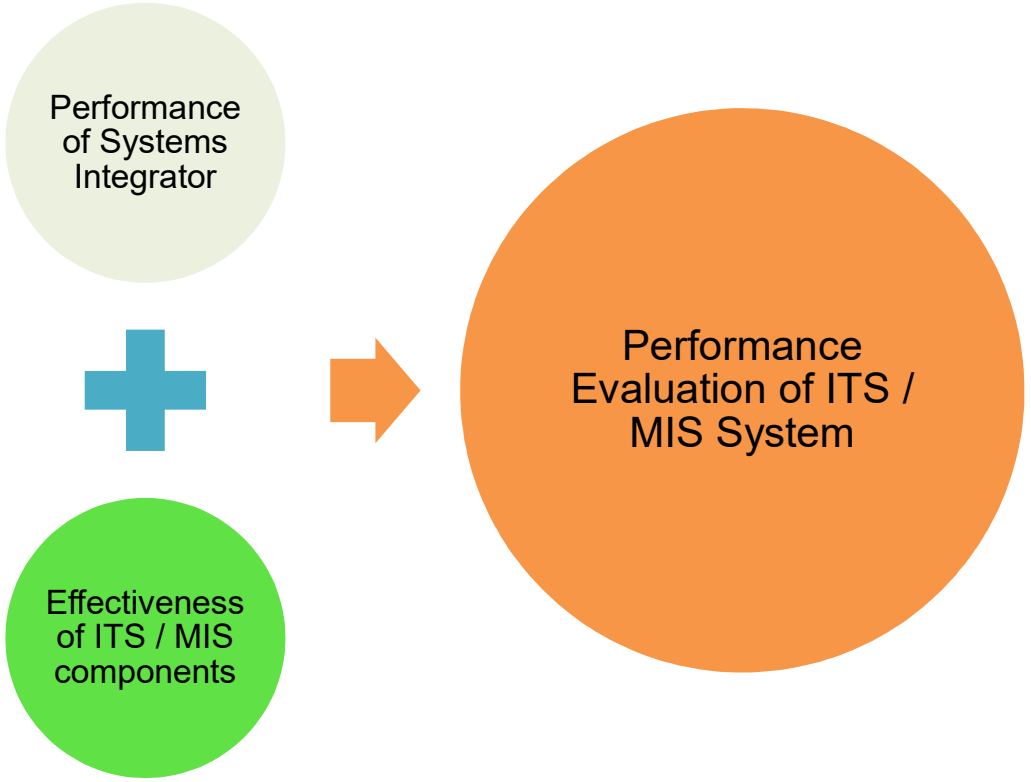
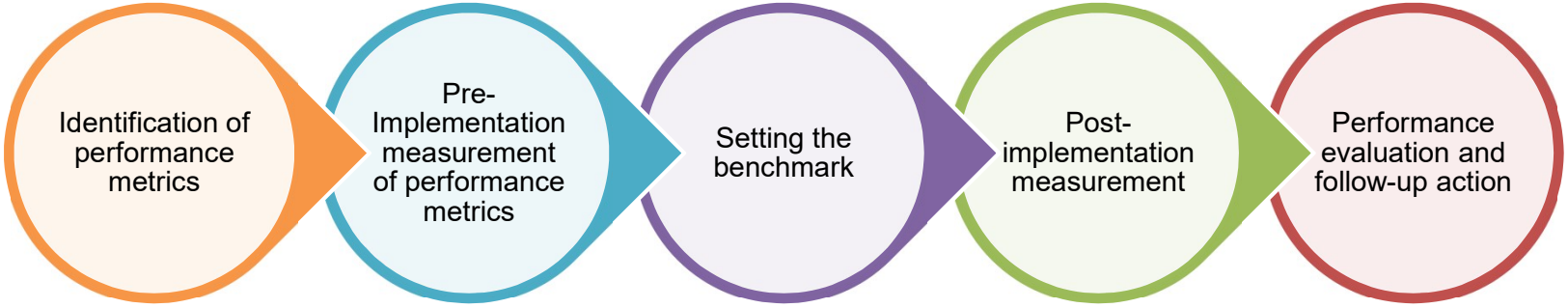
Evaluation of the System

- Importance of conducting periodic evaluation
- Identification of right performance metrics
- Importance of drawing a follow-up action plan after each evaluation exercise

Two Aspects of Evaluation



Process of Performance Evaluation



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