

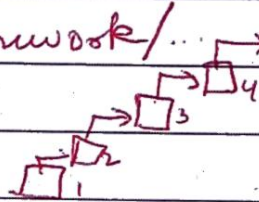
## Software process

set of related activities  $\xrightarrow{\text{leads to}}$  production of SW products.  
 $\downarrow$  (4)

- ① SW specification — functional constraints
- ② SW D & I
- ③ Validation
- ④ Evolution: meet changing custom needs

## Software Maturity Framework / IRDMO

Explain diff types of process



- ① Initial -
  - ① process under statistical control
  - ② orderly progress in increments X
  - ③ must attend attention to schedule & cost
- ② Repeatable:
  - ① org behind stable process
  - ② along with repeatable level of stat control
  - ③ Initiating orgs PM commitment, costs, schedule & class
- ③ Defined -
  - ① org defined process
  - ② Basis -
    - ① consistent implementation
    - ② Better understanding
  - ③ Advance tech used
- ④ Managed: -
  - ① org initiated comprehensive
  - ② Process measured & analysis
  - ③ Most significant quality improvement
- ⑤ Optimising -
  - ① org has foundation
  - ② for continuous improvement
  - ③ & optimization of process

- diag. L1 - process unpredictable, poorly controlled & creative
- L2 - process categorised for projects & often creative
- L3 - process categorised for org & is proactive
- L4 - process measured & controlled
- L5 - focus on process improvement

## 6 principles of SW process changes.

- ① Major changes to the SW must start at the top  
a leadership b managers.
- ② Ultimately everyone must be involved.  
Immature → Matured → people → Repair process.
- ③ Effective changes require a goal & know of current process.  
current status - asst → help in
- ④ Change is continuous  
Imp to use that iterative process over time status.
- ⑤ SW process changes need periodic Asst.  
Install, practice, profit, National any process & assets work is hard..
- ⑥ SW process improvement requires investment.  
self evident, manager rely on ppl - Imp SW process - unplanned SW

## SW process Assessment :-

SW process Asst helps org improve themselves by identifying what needs to be improved & establishes important priorities.

- ① 3 basic objectives: Learn, Identify, control.
- ② Is it an audit? no, review, has to improve.
- ③ Phases - Preparation (so. mgmt), Onsite Asst, Recommendation.
- ④ principles → process model.  
→ confidentiality  
→ so. mgmt involvement  
→ Respect for views of ppl.  
→ Action Based on Recommendation

## ⑤ steps

- ① preparation - scope, team, docs.
- ② Asst - conduct interview, review docs, gather info.
- ③ Evaluation - info gathered is compared to framework.
- ④ Report - summary, recommendation.
- ⑤ Action - implement changes.
- ⑥ Follow up - verify changes made have been effective.
- ⑦ continuous imp - improve.
- ⑧ compliance - std, reg, ISO 9001

## Initial process

9

why

- ① first stage
- ② starts pt for orgs SD
- ③ defined — scope  
— obj  
— Req.
- ④ sets foundation
- ⑤ project plan created  
team assembled
- ⑥ includes — proj schedule  
— budget
- ⑦ Mitigate Risks
- ⑧ A.R.A — project initiation  
plan phase

- ① Orgs are chaotic — lack of commitment.  
— extreme pressure.  
— mae code.  
— risks.

② unplanned commitments

helps: Gyurus.  
Magie

③ the way out

- ① Apply systematic plan.
- ② Adhere to careful change control
- ③ utilize independent SW assume.

## ⑩ Principles to control design

- ① plan the work
- ② divide the work into individual parts
- ③ define the req. for each part
- ④ Recognize what you're doing
- ⑤ Manage, assess & review the work

## Repeatable process

- ① L2
- ② commitments
- ③ clear — estimated budget, time, i/p, o/p
- ④ Principles — Plan Based on Hierarchy  
① Resolve conflicts  
② Review audits  
③ Track progress against plan

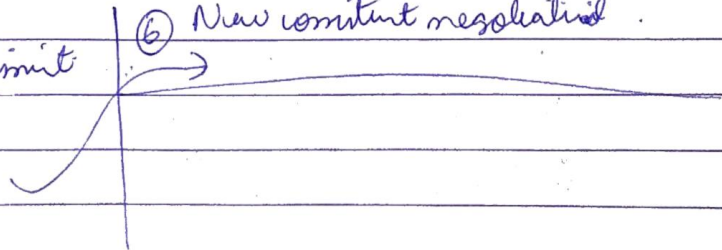
⑥ Other teams

- Product as period plan
- Contention plan

## ③ Elements of effective commitment

- ① willingly
- ② no light commitment
- ③ Agreement
- ④ openly stated
- ⑤ Ask for help

⑥ New commitment negotiated



## Defined process 23.

① achieved foundation for major cc. Contiprogress.

② decide how to improve.

③ only qualitative.

④ data is undualid.

⑤ items r measured.

⑥ focus on measurmt cc specific task.

⑦ process arch - essential pre-reqs.

⑧ Key steps

① Establish min process measmts.

② establish process db.

③ Provide sufficient Resources.

④ Assess Relative Quality.

## Managed process.

① 24.

② problem: cost gathering of data.

③ Valuable measur - expensive to collect cc. mantri.

④ Product's data - messy.

⑤ diff group gather data but do not use identical def.

⑥ process data must not be used to compare projects.

⑦ purpose - eliminate the product being developed cc.  
provide info for improve process.

⑧ fundamental req - Support automatic gathering of process data.  
Use process data to analyse cc. improve effci.

## Optimizing process.

① 25

② Largest source of cc on products.

③ gather cc. analyse only data.

④ data available to time the process.

⑤ error can be identified by code / design than test.

⑥ Error traps - Interfaces performance, human factors, error reasons.

⑦ 2 aspects of tests - removal of defects.

⑧ Identify weakest elements cc. fix them  
asst of prog quality

## S/W Economics Improvement?

- |                       |                            |
|-----------------------|----------------------------|
| ① process improvement | ⑤ Resource optimisation    |
| ② Automation          | ⑥ Risk mgmt                |
| ③ Reuse               | ⑦ Performance optimisation |
| ④ Outsourcing         | ⑧ Cost benefit Analysis    |

depends on specific content & constraint  
also imp - well implemented SD prods.

M.M.M.M. → make demands  
↓  
monitors metrics

## S/W Lifecycle Phases

→ The phase & order may vary depends upon model.  
But common Phases:

- ① Req Gathering & Analysis - goals, obj, needs of stake.
- ② Design & Architecture - func non func.
- ③ Coding & Implementation - code, dev
- ④ Testing & Debugging - unify, fix defects.
- ⑤ Deploying & Configuring - Install/configuring production.
- ⑥ Maintenance & Monitoring → M.M.   
Make changes.   
emission anal to address

## Importance of S/W Arch.

→ S/W Arch is high level structure in S/W system

→ Key Benefits of good S/W Arch.

- |                   |                    |
|-------------------|--------------------|
| ① Quality         | Cost-effectiveness |
| ② Maintainability | Better communi.    |
| ③ Scalability     | Reusability        |
| ④ flexibility     |                    |

tasks alt next sprint.

Iteration plans itt.

process used - Agile SDM.

Team plans & commits - fixed time - set of task comp.  
(1-4 weeks).

Team reviews -

- ① previous iteration.
- ② prioritize tasks for upcoming itt.

### Pragmatic

flexible approach to plans

practical aspects -

- ① team abilities
- ② available resources.

focus - continuous improvement  
changing circumstances

### WBS issues / Planning guide

- ① lack of clear objectives
- ② too detailed
- ③ lack of buy-in from stakeholders

#### Guidelines

- ① clearly define
- ② keep it simple.
- ③ get input from stakeholders
- ④ use proj mgmt tools

### WBS - Work Breakdown Structure

- ① Hierarchical
- ② tree like struct
- ③ project obj & deliverables
- ④ 3 levels - high - overall  
↳ - major components  
low - specific task of each comp.

- ⑤ used: call work
- ⑥ input: T, A & cost
- ⑦ define: scope, budget, schedule
- ⑧ created: in collaborative way
- ⑨ Review & updated
- ⑩ It's imp tool for proj plan & mgmt
- ⑪ created by PM & his team to que
- ⑫ helps to identify dependencies & rd

## Principles of S/W PM VS conventional PM.

### Similarities - Both

① focus - PEMCC.

Plan, exec, moni, cont, close.

② Req - CC - com, collab.

Team mems & stakeholders.

③ Rely - TT - Tools, Tech.

PERT, Gant charts, critical path anal.

### Differences

SPM	CPM
① dev of s/w.	① wide range of projects.
② special skill ① prog s/w methods	② general.
③ flexibl ① ultimat ② req change.	③
④ Req ① testing ② quality.	⑤ budgeting risks.
⑤ susceptibl - Technical risks	
⑥ Reliab - Metrics ② measurmt.	
⑦ complianc -	

Round trip engineering | Ability to move diff levels of abstraction & rep

Improved collab. - dd using tt.

Increased productivity - Automate & upate.

① design models

② some code

Supports - Agile, Waterfall, unimodal.

ensure consistency.  
 Sync b/w design & code.  
 Improve productivity Reduce errors

- ③ Better traceability - help to
  - ① identify fix errors and
- ④ Reduced maintain cost
- ⑤ Improved quality - thorough
  - ① testing
  - ② validation
- ⑥ Improved reusability. - code / design model.  
 help to reduce - dev time & cost.
- ⑦ Better docs: ① accurate ② complete ③ up to date  
 help - reduce ~~use~~ confusion & errors.
- ⑧ Better comm - TM, stake  
 help - slow system needs require

Improved	Better
① collaboration - dd, tt	① traceability - idfy errors
② productivity - AV, MC	② docs - conf, acc
③ quality - F, V	③ commu - TM, SK
④ Reusability; ↓ dev time cost	④ Reduce maintain cost -

### Planning Guidelines

- ① Define clear project objectives: stakeholder understanding  
 ↓ goals, obj
- ② Identify & manage risks.
- ③ Create a detailed project plan.
- ④ Define project scope.
- ⑤ establish communication plan.
- ⑥ Identify & manage dependencies.
- ⑦ set realistic timelines & budget.



## Evolutionary WBS with escape

- ① method - incrementally & iteratively
- ② used - when proj scope is not understood at begin
- ③ developed - in stages - each stage in detail
- ④ living document - updated continually
- ⑤ Eg: AS/w dev project starts with high level task Ruzi & Imphit. is broken down into more specific subtasks.
- ⑥ flexibility
- ⑦ adaptability
- ⑧ Reduces Risk of Scope
- ⑨ ensures that proj stays on schedule & within budget

### Cost Estimation

- ① cost of proj
- ② cost of proj component

### Schedule Estimat

- ① duration of proj
- ② duration of proj component

- ③ Based on historical data, expert judgment, relevant info.
- ④ dev proj budget
- ④ dev proj plan
- ⑤ Help to determine if project is feasible
- ⑥ Both cost & schedule should be done in parallel
- ⑦ Cost & schedule estimates will be refined as the project progresses & new info becomes available.

### 3\* Milestones Major

- ① Significant event/achievement marks the completion of major proj phase.
- ② track progress
- ③ Measure performance
- ④ start at beginning
- ⑤ used to identify Key deliverables  
deadlines
- ⑥ Includes - Req 8, DDTD.  
expand each pt for major milestones

### 3\*. Quality Indicators

- ① defect density -  $\downarrow$  DD  $\uparrow$  Q.
- ② time to market -  $\uparrow$  time to bus product, indicates efficiency.
- ③ customer satisfaction - needs, reputation.
- ④ code maintainability - code understood, modified, extended.
- ⑤ compliance - std, rules, Reg, better quality & reliability.

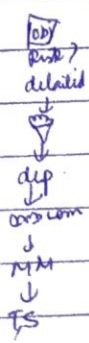
### 5\*. Requirements to have separate team for Asst & delivery team over project life cycle:

- |                          |                |
|--------------------------|----------------|
| ① Objectivity            | ⑤ Compliance   |
| ② Expertise              | ⑥ Benchmarking |
| ③ Independent            | ⑦ Planning     |
| ④ Continuous improvement | ⑧ Auditing     |

### 5\*. Signing vs production stage

- |                           |                                |
|---------------------------|--------------------------------|
| ① RQA                     | ① Rep & Inst                   |
| ② DQA                     | ② Config & custom              |
| ③ C&I                     | ③ user acceptance tests        |
| ④ T&D                     | ④ performance monitor & limits |
| ⑤ Integrity & system test | ⑤ Maintenance support          |

### 3\*. Planning Guidelines



- |                                   |  |
|-----------------------------------|--|
| ① Define clear project objectives | ⑥ Identify & manage dep.               |
| ② Identify & manage risks         | ⑦ Set realistic timeline & budgets     |
| ③ create detailed project plan    | ⑧ Continous monitor & measure progress |
| ④ Define project scope            | ⑨ Identify & manage changes            |
| ⑤ Establish communication plan    | ⑩ Have contingency plan                |

### Major Milestones, SDLC, Models, Engineering

- ① Requirement Gathering
- ② Design
- ③ Develop
- ④ Test
- ⑤ Deploy
- ⑥ Maintain

57  
CCPDS R process with macroprocess /  
milestone / Schedule.

① Computer Aided Cost performance Trade off  
defense system Reusid.

② S/W tool dev by S&US DOD. Co

③ Cause - use of sys in engineer process.

④ Analyse & compare - cost & performance of diff systems  
design for cost effort.

⑤ util several macroprocesses.

① Concept development - define sys concept  
- identify key cost  
- performance drivers.

② Requirement analysis - dev detailed set of req.  
- identify tradeoff.

③ Concept Exploration - develop, evaluate based on sea, cost.

④ Concept Selection - effutini design.

⑤ Cost & Schedule Estimation.

⑥ Risk Managmt.

⑦ Implement.

248. When the process Repeatable?

① Allows predictability & efficiency in Proj dev.

② Team can use prev experience & knowledge to imp per & predict.

③ Can increase Quality & consistency of s/w deliverables.

④ Reduce Risk errors & Improve Overall efficiency.

⑤ Can help to standardise work flow & improve comm.

Process Automation

① Automate repetitive, manual, time consuming tasks.

② ↑ efficiency, ↓ error, ↑ overall process performance.

③ Applied to variety of processes

① Manufacturing ② Finance ③ Supply chain mgmt.

④ Finance ⑤ S/W dev.

④ tools: (a) robots (bots).

(b) ML algos.

(c) workflow s/w.

(5) automate tasks (a) data entry (b) scheduling (c) comm.

(6) Realtime - monitor & analyse process.

(7) help.org - (a) scale operations

(b) improve custom service.

(c) reduce cost.

(8) imp to evaluate feasibility

(9) ensure automation sol is integrated with exist. syst.

### \* 7 key metrics of process control:-

Cycle time - start to finish.

Lead time - places an order till delivered.

Yield - % of prod/service meet Quality standards.

Defect Rate - defects/unit of production.

Throughput - no. of units produced/unit of time.

Utilization - % of capacity being used.

Capacity - Max o/p that a system can produce.

All these metrics help to measure the performance of process & identify areas of improvement.

### Basic fields of S/w Change

① It's a doc.

② describes requested change

③ include - Reason for change.

④ Scope of change.

⑤ Impact on project schedule & Budget.

⑥ Used - track & manage changes.

⑦ Ensure - properly approved & implement.

Basic fields

## Basic fields:

- (a) Change requested no. - unique id for change req.
- (b) Description - detailed explant
- (c) Impact - cost, scope, schedule.
- (d) Approval - who?, date, sign.

SA

## SW project Quality Key Indicators

- ① metrics
- ② eg: defects per KLOC, test coverage, customer satisfaction
- ③ help - ① areas of imp  
② measure success of QA efforts.
- ④ QA indicators @ defect density. | ③ Customer satisfaction.  
⑤ test coverage. | ④ Maintainability.

## Life cycle Planning Balance.

- ① Balance various aspects
- ② Factors: cost, schedule, Q, RM
- ③ Goal: optimize trade off & achieve overall optimum.
- ④ Key elements: 

Prioritize	Manage Risk
Monitor	Cont Eval
Max	

## Modern process Transition

- ① Change & evaluation criteria
- ② adoption to new @ process | ③ tools  
④ practices
- ③ eg waterfall → Agile & Devops
- ④ Key elements: ① Adoption  
② Eval & improve  
③ collab, communicate  
④ incorporate feedback & customer perspective.

5\*

## Next Gen S/W Economics

- ① new tech; new digital tech.
- ② Approaches to improve effin, effectivness, ROI.
- ③ Issues - data driven, automation, ML to optimize.
- ④ New Busin Mods (SaaS & CC)
- ⑤ new Procurement Models - outcome Based Pricing
- ⑥ New Governance Models - Platform Based Approachs.
- ⑦ Aims: Reduce cost, ↑ productivity, improve overall.
- ⑧ fields: AI.
- ⑨ helps:
- ⑩ Overall dev: DDTD.

3\*

## Evaluation requirments

- ① decisions re reqirments re & interaction (Refus)
- ② Issues: continue fb, collab b/w SK & dev.
- ③ Approach allow: change re reqirment early.
- ④ Results: 

① I.I.	↑↑, ↑	⑤ Rev, update.
② CC		⑥ Flexible.

3\*

## Early Risk Resolution

- ① Identify & address potential risks in early stage.
- ② Issues proactive meas. to manage potential impact of an on.  
④ Schedule ⑤ Budget ⑥ Quality.
- ③ By Identify & Mitigate Risk use of - orgs are train re person
- ④ Results:
  - ① Identify
  - ② Implement RM plan:
  - ③ Monitor
  - ④ CC.

### 37. Evaluation of Orgs.

① Refs: process of able assess performance & effctive way

② methods: structure  
process } to identify areas of improvt.  
culture }

③ Evaluation done: (a) internally  
(b) org  
(c) external

④ Disadvts: Identify | Measure perform.  
Analyse. | Dev & Imp plan.

### 38. Metrics Automation :-

Refs: its the use of tech to automaticaly collect & ab report.

tools nd scripts: to gather data

ML algo: analyse data & identify pateris.

Adv help: its identify trends & areas for improvt more quickly

eg: ① code quality metrics | ③ performance metrics  
② test coverage | ④ user engagement

### Cost & Schedule estimation process & project Planing

① methods - predict amt of time & resources.  
- analysis proj req.  
- identify potential risks.  
- Estimate Resources & Duration.

C&S.

- defining & organising task & activities.  
- creating detailed project schedule.  
- develop resource plan.  
- identify dependencies.

PP.

Both are closely related

① done parallel

- breaking down into small parts to manage.
- prog must be completed within budget & schedule
- users are updated

## A typical project would have six iteration projects

① Inception - @ initial phase

② project goals, scope, reqs defined.

③ Identify key stake.

④ create high level proj plan.

⑤ determine features

② Elaboration - @ detailed - major constraints

③ detailed - proj plan, risk, schedule.

③ Construct

① dev

① debug

② Implement

② integrate

③ test

④ Transition - @ deploying - production

② train and users

③ test software in production environment

⑤ Production - @ software used by end users.

② Monitor

③ Maintain

④ Support

⑤ Customisation

⑥ Retirement - @ final

② archive

③ evaluate success

④ identify lessons



## Best practices of SW Management

- 1 Define clear goals & objectives
- 2 create a detailed proj plan & schedule.
- 3 Prioritize & Manage Risks effectively
- 4 CC
- 5 Monitor progress & adjust plans as needed
- 6 continuous assess & improve process
- 7 Use metrics to measure performance & cont improv
- 8 Encourage innovation & experimentation
- 9 Focus on team & work .. improv
- 10 Engage in regular perform eval

### PSP

- 1 Personal SW process
- 2 focus: individual performance.
- 3 emphasis: personal accountability
- 4 used by: individual dev

### TSP

- 1 Team SW process
- 2 Team performance.
- 3 emphasis: team accountability
- 4 used by: teams of dev.

### Common:

- 1 improving productivity & Quality
- 2 Use Measurements
- 3 Training & coaching
- 4 Iterative process
- 5 process improvement
- 6 Scalable

## CMM

- ① Capability Maturity Model.
- ② Framework: for assess maturity of org
- ③ 5 levels → initial to optimized.
- ④ each level → specific char & practices to be met.
- ⑤ Dev. by - SEI at Carnegie Mellon University.
- ⑥ widely used in SW & indus.
- ⑦ evaluate & improve SD process.
- ⑧ Used to assess Maturity of single proj or entire org.
- ⑨ replaced by CMMI.
- ⑩ SW process model.

### L1

- ① no KPA's defined
- ② process followed & adhoc variation not well defined.
- ③ unstable commitment, work informal

### L2

- ① focus on establish basic PM policies
- ② project plans & tracking
- ③ config & Resour mgmt
- ④ SW QA
- ⑤ poor successful project strategy

### L3

- ① docs, well defined.
- ② quality & products.
- ③ org process definition
- ④ " " focus.

### L4

- ① Quality & goals.
- ② Quant's
- ③ SW process.
- ④ SW Quality mgmt.
- ⑤ SW Quantitative mgmt.

### L5

- ① highest level.
- ② use of new tools tech.
- ③ eval of SW process
- ④ importance of alternatives  
↳ defect prevention  
Tech chos.  
eg: logjart, hpcu

# CMMI

- ① Capabilities Maturity Model Integration
- ② SGS - meta model
- ③ 

contin. model	Staged Model
(2P)	

32132

Def: PP - project planning  
REQM - Req. mgmt  
MA - Mgmt & analysis  
CM - Config Mgmt  
PPQA - process product QA



Essentially same as CMM

## Workflow of process

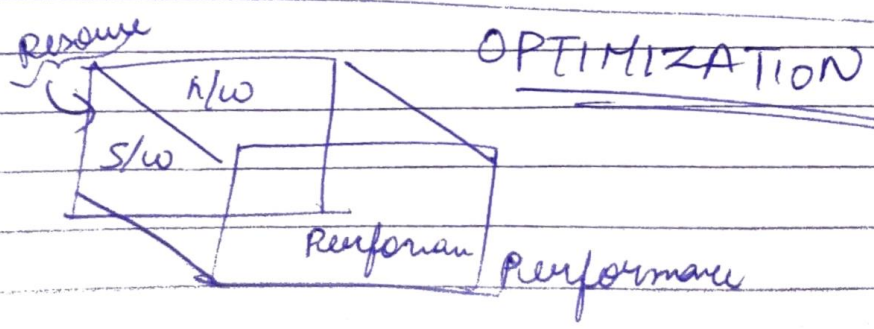
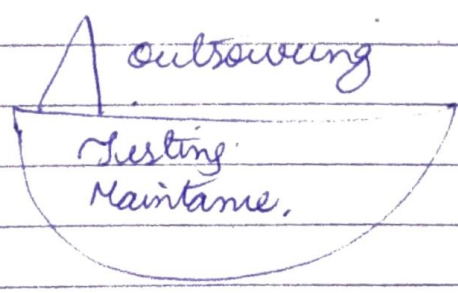
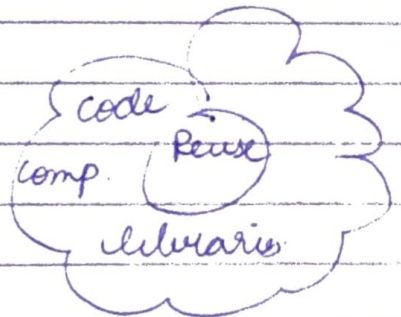
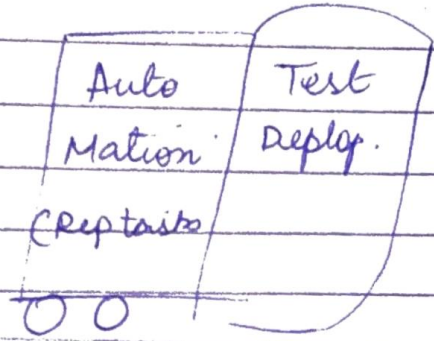
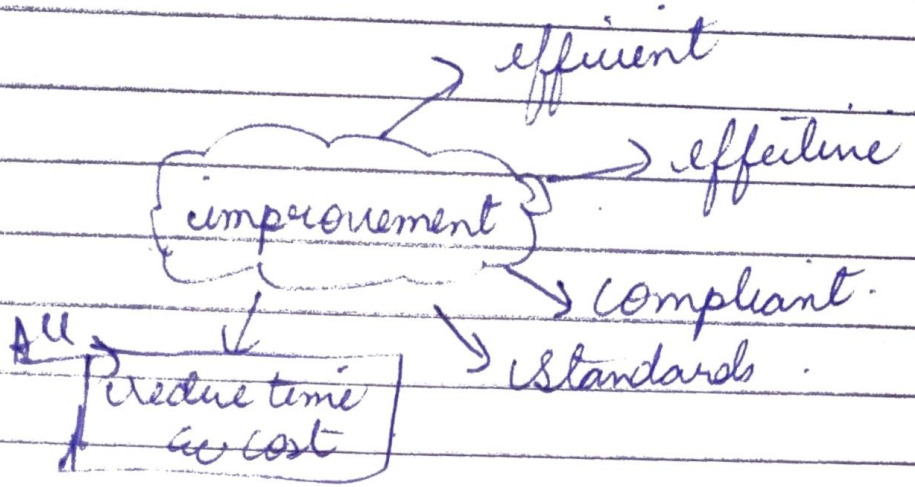
- |             |          |
|-------------|----------|
| ① Mgmt wf   | ⑤ Imp wf |
| ② Inv wf    | ⑥ Ass wf |
| ③ Req wf    | ⑦ dep wf |
| ④ Design wf |          |

## Checkpoints

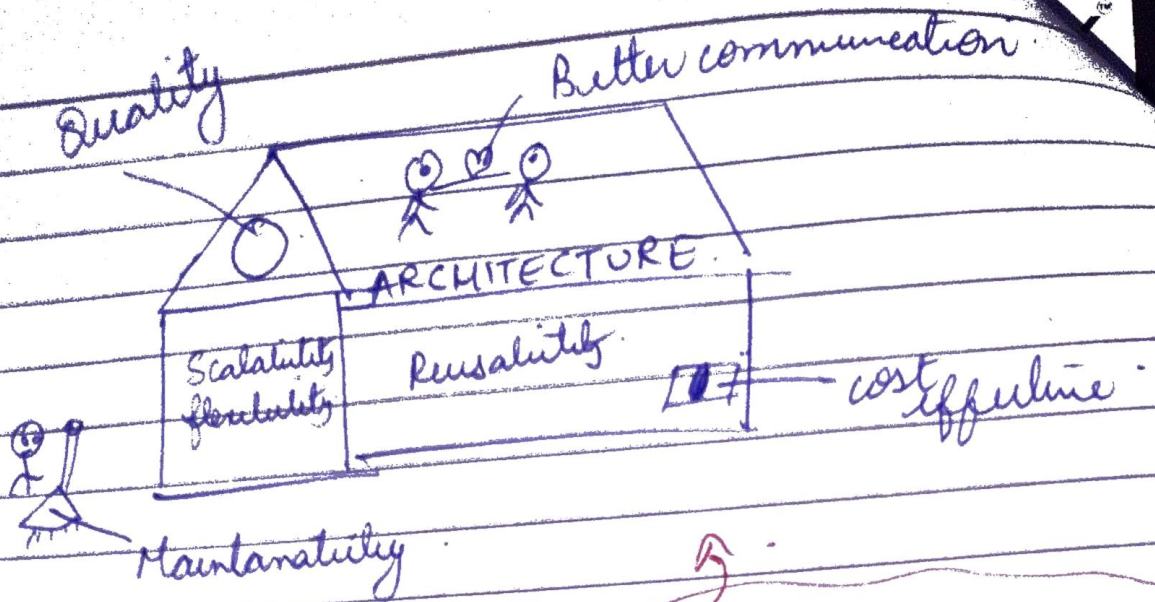
- ① major checkpoints - system under const.
- ② life cycle obj milestone (end of unipli phase)  
admi stakeholders
- ③ life cycle subitl milestone (relaxation phase)  
Arch shown task
- ④ Product Release Milestone (const phase)  
Rmm Quality  
(transition phase)  
Complex

Minor checkpoints

definition side pts with description.

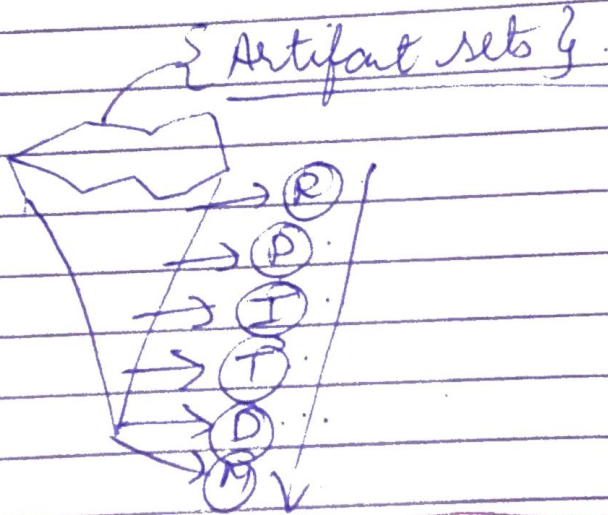


Q

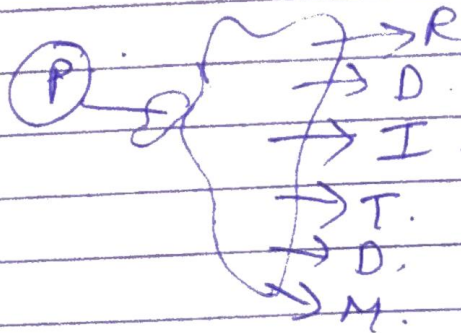


Q

Imp of S/W Architec



Q



Disis state of  
Plans, Rev & Prock  
for various  
Milestos

## Key points Repetitive

- ① Scalability
- ② flexibility
- ③ Reusability
- ④ Maintainability
- ⑤ cost-effective
- ⑥ Better communication
- ⑦ Quality
- ⑧ Req. Gathering & Analysis
- ⑨ Design & Architecture
- ⑩ code & Implementation
- ⑪ Testing & debugging
- ⑫ deployment & config
- ⑬ Maintain & Monitor
- ⑭ Improvement - <sup>efficient</sup> <sup>effective</sup>
- ⑮ Optimisation - <sup>Resource</sup> <sup>performance</sup>
- ⑯ Automation
- ⑰ Outsourcing
- ⑱ Risk Mgmt
- ⑲ Objectives
- ⑳ Deliverables
- ㉑ Goals, Activities, tasks
- ㉒ Design, develop, test
- ㉓ collaboration
- ㉔ Team members & Stakeholders
- ㉕ Reviewed
- ㉖ Updated
- ㉗ current Status
- ㉘ defect density
- ㉙ customer satisfaction
- ㉚ compliance with Standards
- ㉛ support.
- ㉜ customisation
- ㉝ Integration
- ㉞ planning
- ㉟ conducting assessments
- ㊱ analysing
- ㊲ recommending
- ㊳ constraints
- ㊴ feedback
- ㊵ project lifecycle
- ㊶ Reliable
- ㊷ M-Monitor
- ㊸ Maintain
- ㊹ Metrics
- ㊺ Measurement
- ㊻ Expertise
- ㊼ Benchmarking

imp note: may vary depending on methodology / model  
imp to have well defined & well implemented SD  
ways to MM & track the progress

48 Timeliness

49 Schedules

50 Budgets

51 Contingency

52 Dependencies

53

54 Productivity

55 Usability

56 Docs

57 Execution

58 Levels — Initial  
Managed  
Refined

Quantitatively Managed

Optimising

59 Training

60 Align with Business Goals

61 Follow up

62 Evaluation

63 Action

64 Report

65 Assessment

66 Preparation

67 Leadership

68 Scope

69 Requirements

70 Foundation

80 Continuous Improvement

81 Changing Circumstances

68 Focus

69 Standardisation

70 Innovation

71 High performance culture

72 Prioritize

73 Iterative process

74 Reviews

75 Root Cause

76 QA