

Software process

set of related activities $\xrightarrow{\text{leads to}}$ production of SW prodn.
 ↓④.

① SW Specification $\xrightarrow{\text{functions}}$ constraints

② SW Dev I.

③ Validation

④ Evolution: meet changes in customer needs

Software Maturity Framework / (IRDMO)

Explain diff types of process



① Initial - ① process under statistical control

② orderly process in unjoined 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 org gone 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 uninitiated comprehension

② Process measured & analysis

③ Most significant quality improvement

⑤ Optimising : ① org has foundation

② for continuity improvement

③ & optimisation of process

diag : L1 - process unpredictable, poorly controlled & creative

L2 - process categorised for projects & often creative

L3 - process categorised for org & is predictable

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

② leadership ③ 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

④ Change is continuous

→ up to now that iterative process was more static

⑤ SW process changes need periodic Asst

Install, practice, Profit, Natural as well as amate works hard

⑥ SW process improvement requires commitment

self-reliant, manager rely on ppl → Imp SW process - implement SW

SW process Assessment:

SW process Assst helps orgs improve themselves by identifying critical problems

→ establishes improvement priorities

① 3 basic objectives? Learn, Identify, correct

② Is it an audit? no, review, has to improve

③ Phases - Preparation (So. mgmt), Onsite Assst, Recommendation

④ principles → process model

→ confidentiality

→ So. mgmt involvmt

→ respect for rights of ppl

→ Action Based on Recommendation

⑤ steps

① preparation - scope

② Assst - conduct interviews, review docs, gather info

③ Evaluation - info gathered is compared to framework

④ Report - summary, review

⑤ Action - implement changes

⑥ Follow up - verify changes made have been effective

⑦ continuing - upgrade

⑧ completion - std, reg, ISO 9001

Initial process

- ① first stage
- ② starts pt for orgs sp
- 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
planning phase

(9)

why

- ① orgs are chaotic = lack of commitment.

- extreme pressure
- more code
- risks

- ② unplanned commitments

helps: gurus
Magic

- ③ the way out

- ① apply systematic plan
- ② Adhere to careful change control
- ③ utilize independent assme.

⑩ Principles to control design

- ① plan the work
- ② divide the work into small parts
- ③ define the res for each part
- ④ recognize what you're doing
- ⑤ Manage assce from the code

Repeatable process

- ① L2

- ② commitments

- ③ clear — estimated budget, time, i/p, o/p

- ④ principles — Plan Based on Morality

- ① dissolve conflicts

- ② Review audits

- ④ Track progress against plan

(6) Other teams

— productee period plan

— contention plan

② 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 (antisepos)

② decide how to improve.

③ Only qualitative.

④ data is undetailed.

⑤ items & measured.

⑥ focus on measurement & specific task.

⑦ process arch - essential pre-requisite.

⑧ key steps

① Establish min process measnts.

② establish process db.

③ Provide sufficient Resources.

④ Assess relative quality.

Managed process

① L4.

② problem & cost gathering of data.

③ Valuable measures - expensive to collect & maintain.

④ Productivity data - meaningless.

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 & to provide info for improving process.

⑧ fundamental use - Support automatic gathering of process data.

use process data to analyse & improve effici.

Optimizing process

① L5

② Large focus on products.

③ gather & analyse only data.

④ data available to tune the process.

⑤ errors can be identified by code/design chart test.

⑥ error graphs - interface performance, human factors, user reviews.

⑦ 2 aspects of tests - removal of defects

⑧ Identify weakest elements & fix them

S/W Economics Improvement?

- | | |
|-----------------------|---------------------------|
| ① Process improvement | ② Resource optimisation |
| ③ Automation | ④ Risk mgmt |
| ⑤ Reuse | ⑥ Performance optimisatn. |
| ⑦ Outsourcing | ⑧ cost benefit Analysis |

depends on specific context as constraint
also imp - well implemented SD process.

M M M M → make
months mean the Metrics decisions.

S/W Lifecycle Phases

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

- ① Req Gathering Analysis - goals, obj, needs of s/w.
- ② Design & Architecture - func & non func.
- ③ Coding & Implementation - code, dev
- ④ Testing & Debugging - rectify, fix defects.
- ⑤ Deploying & Configuring - Install/config in production.
- ⑥ Maintenance & Monitoring → MM. remove
make to
reduce
make changes.

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-effective |
| ② Maintainability | Better communi. |
| ③ Scalability | Resourceful |
| ④ Flexibility | |

Iteration plans iff.

process used - Agile SDM

Team plans & commits - fixed time - set of tasks
(1-4 weeks)

Team reviews - ① previous iteration

② prioritize tasks for

upcoming iff.

Pragmatic

flexible approach to planning

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 structure

③ project objective delineation

④ 3 levels - highest - overall

↳ - major components

↳ - specific task of
each comp.

⑤ used: overall work

⑥ ensure: T, A & cost

⑦ defines: scope, budget, schedule

⑧ created: in collaborative way

⑨ remains as updated

⑩ its a tool for proj. planning & mgmt

⑪ created by PM or big team to guide

⑫ helps to identify dependencies and

Principles of S/w PM vs conventional PM.

Similarities - Both

① focus - PEMCC.

Plan, exec, moni, contr, clos.

② Req - CC - com, collab.

a Team membe & stakeholders

③ Rely - TT - tools, Tech.

PERT, Gant charts, critical path anal.

differences

SPM

① dev of s/w.

② Special skill

① prog ② s/w method

③ flexible

① iterative

② req change

④ Req ① testing

② quality

⑤ susceptible - Technical risks

③ budgeting risks.

⑥ Relies - Metrics

② measurmt

⑦ compliance -

CPM

① wide range of projects

② general

③

Round trip engineering Ability to move diff levels of
Illustration &

Improved collab. - dd using tt

rep

Increased productivity - Automate & update

① design models

② son code

Supports - Agile, Waterfall, incremental

Ensures consistency.

Syntax b/w design & code.

Improve productivity. Reduce errors

③ Better traceability - help to

① Identify & fix errors early

④ Reduced maintenance cost

⑤ Improved quality - through

① testing

② validation

⑥ Improved reusability - code / design model.

help to reduce - due to E cost.

⑦ Better docs - ① accurate ② complete ③ up-to-date

help - reduce ~~confusion~~ E

⑧ Better comm - TM, stake

help - SW system meets user

Improved

① collaboration - dd, tt

② productivity - AV, MC

③ quality - Q,V

④ Reusability; ↓ dev time
cost.

Better

① Traceability - id ty errors

② docs - conf, user

③ commun - TM, SK

④ Reduce mainten. cost -

Planning Guidelines

① Define clear project objectives : stakeholders involved
↳ 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 & budgets.

Evolutionary WBS with example

- 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 e.g.: A software project starts with high level task Design System.
is broken down into more specific subtasks.
- ⑥ flexibility
- ⑦ adaptable
- 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 Estimation

- 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 as new info becomes available.

3. Milestones Major

- ① significant event/achiev marks the completion of major project phase
- ② track progress
- ③ measure performance
- ④ set at beginning
- ⑤ used to identify key deliverables
deadlines
- ⑥ includes - Fig 8, DDFD

expand each pt for
major milestone

3* Quality Indicators

- ① defect density - ↓ DD ↑ Q.
- ② time to market - para time to bus product, indicates efficiency
- ③ customer satisfaction - needs expectation
- ④ code maintainability - code understood, modified, re-used
- ⑤ compliance - std, rules, Reg., fulfill quality & reliability

4* Requirements to have separate team for Ass't & Activity
Team over project life cycle:

- | | |
|--------------------------|----------------|
| ① Objectivity | ② compliance |
| ② expertise | ③ Benchmarking |
| ③ independent | ④ Planning |
| ④ continuous improvement | ⑤ Auditing |

5* Engineering	VS	production stage
① R & GA		① Proc Inst.
② Dev A.		② config & cust.
③ Cee I.		③ user acceptance
④ T & D.		④ performance monitor & tuning
⑤ Integrate System		⑤ Maintenance support

3* Planning Guidelines

obj
etc?
detailed
plan
dip.
over com.
j.
MM
↓
TS

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

Major Milestones, SDLC, Models, Engineering

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

28

CCPDS R process with macroprocess / milestones / schedule.

- ① Compute Actual Cost performance Trade off defense system Review.
- ② S/w tool dev by SF US DOD Ga
- ③ Cause - use of sys in enginner process.
- ④ Analyze & compare - cost & performance of diff system design for cost effut.

⑤ Init 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 cost, cost

- ④ Concept Selection - effutini design.

- ⑤ Cost & Schedule Estimation.

- ⑥ Risk Managt.

- ⑦ Implement.

28.

When the process Repeatable?

- ① Allows predictability & effutiny in Proj dev.
- ② Team can use prev expurin & knowledge to imp per & Procto.
- ③ Can increase Quality & consistency of s/w deliverables.
- ④ Reduce Risk errors & Improve Overall effutiny.
- ⑤ Can help to standardise work flow & improve comm.

Process Automation

- ① Automate repetitive, manual, time consuming task.
- ② ↑ effutiny, ↓ error, ↑ overall process performance.
- ③ Applied to variety of processes
 - ⓐ Manufacturing
 - ⓑ financial
 - ⓒ Supply chain mgmt -
 - ⓓ Imanie
 - ⓔ S/w dev

- ④ Tools :
 - ① robots (bots)
 - ② ML algos
 - ③ workflow S/W
- ⑤ automate tasks
 - ① data entry
 - ② scheduling
 - ③ comm.
- ⑥ Realtime - monitor & analyse process
- ⑦ help org -
 - ① scale operations
 - ② improve customer service
 - ③ reduce cost
- ⑧ used to evaluate feasibility
- ⑨ ensure automation sol is integrated with existing sys.

* Core 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 cap 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 order

- ① It's a da.
- 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 & implemented

Basic fields

Basic fields:

- (a) Change requested no.:— unique id for changes
- (b) Description:— detailed explain
- (c) Impact:— cost, scope, schedule
- (d) Approval:— who?, date, sign.

SP

Show project Quality by Indicators

- (1) metrics
- (2) e.g.: defects per kLOC, test coverage, customer satisfaction
- (3) help =
 - (1) areas of improvement
 - (2) measure success of QA efforts
- (4) QA undulation
 - (a) defect density | (c) customer satisfaction
 - (b) test coverage | (d) maintainability

Life cycle Planning Balance

- (1) Balances various aspects
- (2) factors: cost, schedule, Q, RM
- (3) Goal: optimize trade off & achieve overall outcome
- (4) key elements:

Prioritise	Merge list
Monitoring	Cont. Eval
Plan	

Modern process transition

- (1) Change & evolution over time
- (2) adoption to new @ process
 - (a) tools
 - (b) practices
- (3) e.g. waterfall → Agile & Devops
- (4) Key elements
 - (1) Adoption
 - (2) eval & improve
 - (3) collab, communicate
 - (4) incorporate feedback & custom perspective

3*

Next gen S/w economics

- ① new tech; new digital tech.
- ② approach to improve efficien, effectiveness, ROI.
- ③ involves - data min, automation, ML to optimize.
- ④ New Busin Mod (SaaS &c)
- ⑤ new Procurement Models - outcome Based Planning.
- ⑥ New Governance Models - Platform Based Approaches.
- ⑦ Aims: Reduce cost, ↑ productivity, Improve overall.
- ⑧ fields: AI.
- ⑨ helps:
- ⑩ Overall dev: DDTD.

3*

Evolving requirements

- ① decisions re refns req & evolutions (Refus)
- ② involves: continuous fb, collab b/w SK & dev.
- ③ Approach allow: changes to adapt early.
- ④ Key elmts: ① IT. ++, ↑ | ⑤ Rev, update.
② CC | ⑥ Flexible.

3*

Early Risk Resolution

- ① Identify & address potential risks in early stage.
- ② involves proactive meas. to minimize potential impact of risk.
- ③ Schedule ④ Budget ⑤ Quality.
- ⑤ By Identify & mitigate risk early - org save time & resou.
- ⑥ Key elmts: ① Identify
② Implement RM plan
③ Monitor
④ CC.

3x. Evaluation of orgs.

① Refers: process of ~~the~~ assessing performance effectiveness

② involves: ultimate ?

process } to identify areas of improvement
culture }

③ evaluation done: ② internally

④ org

⑤ dashboard

⑥ tools: Identify | Measure perforan.

Analyse | Dev & Imp plan

3x. Metrics Automation ?

Refers: to the use of tech to automatically collect data & report

tools and scripts: to gather data

ML algos: analyse data & identify patterns

Also help: to identify trends & areas for improvement over time

e.g.: ① code quality metrics | ③ performance metrics

② test coverage | ④ user engagement

Cost & Schedule estimation process in project Plan:

① involves - predicting cost & time & resources
- analysing project req.
- identifying potential risks.
- Estimating Resources & Timeline.

} C&S.

- defining & organising tasks & activities.
- creating detailed project schedule.
- developing resource plan.
- identifying dependencies

} PP.

Both closely related

② done parallel

- breaking down into small parts to manage.
- proj must be completed under budget & schedule
- review & update

A typical project would have six Iteration phases

① Inception - @ initial phase

- ② project goals, scope, way & defined.
- ③ Identify key risks.
- ④ creating high level proj plan.
- ⑤ determine feasibility

② Elaboration - @ detailed - major re constraints

- ② detailed - proj plan, risk, schedule.

③ Construct

- | | | |
|-------------|--|-------------|
| ② dev | | ② debug |
| ② Implement | | ② integrate |
| ② test | | |

④ Transition - @ deploying - production

- ② train end users
- ③ test software in production envt.

⑤ Production - @ S/W used by end users.

- ② Monitors
- ③ Maintains
- ② Support
- ② customisation

⑥ Retirement - @ final

- ② archive
- ③ evaluate success
- ② 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 access & improve processes
- ⑦ Use metrics to measure performance & cont. improv.
- ⑧ Encourage innovation & implementation
- ⑨ Focus on learnings & work .. improvement
- ⑩ Engage in regular performance

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 products & Qualities
- 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 optimised.
- ④ each level → specifies characteristics to be met.
- ⑤ Dev. by - SEI at Carnegie Mellon University.
- ⑥ widely used in SW & Indust.
- 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 KPI's defined
- ② process followed & adhoc situations are not well defined.
- ③ unstable environment, work informal

L2

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

L3

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

L4

- ① Quality of goals.
- ② Quant. of goals
- ③ SW processes
- ④ SW Quality mgmt
- ⑤ SW Quantitative mgmt

✓ L5

- ① highest level.
- ② use of new tools tech.
- ③ eval of SW process
- ④ Improvement areas addressed
 - ↳ defect prevention
 - ↳ Tech class
- ↳ e.g.: Configuration management

CMMI

- ① Capability Maturity Model Integration
- ② SGS - meta model
- ③ CMMI model → Staged Model.
(2P)

32/32

Def = PP - project planning

REQM - Req mgmt

MA = Measur & analysis

CM - Config mgmt

PPQA - process & product QA



ElSaw ali same as CMM

Workflow of projects

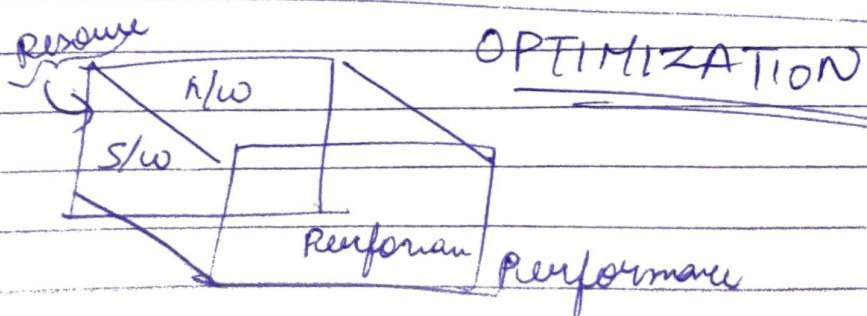
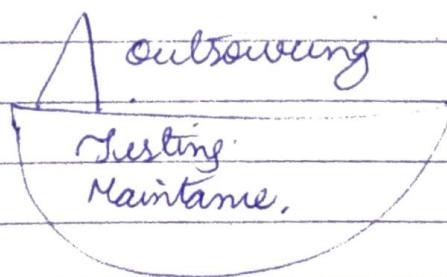
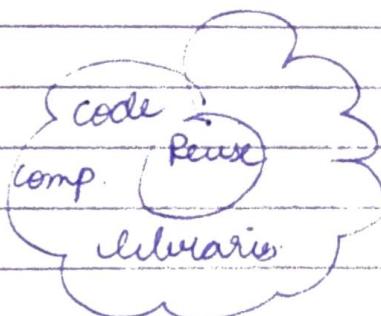
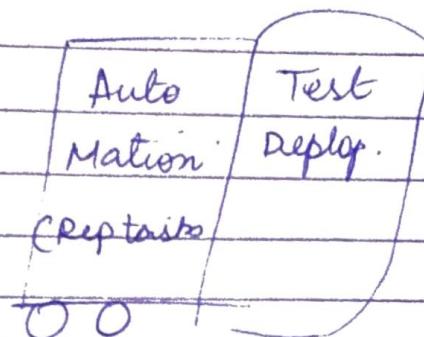
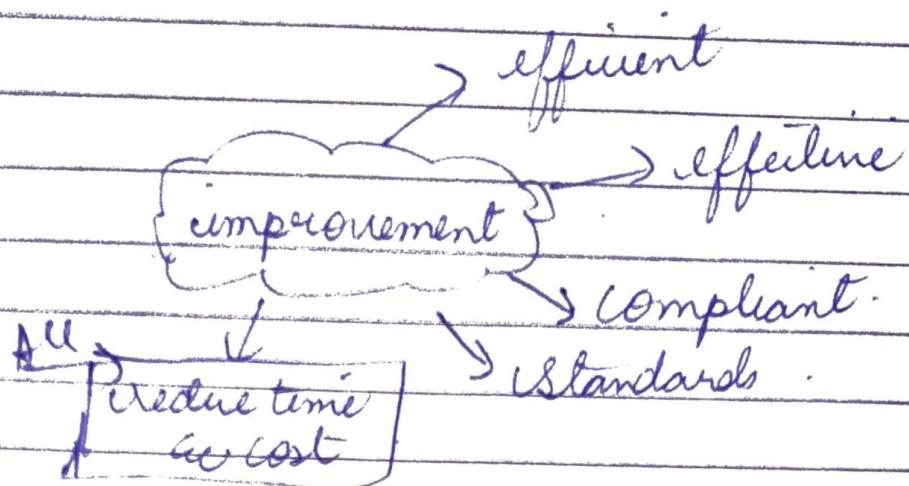
- ① Mgmt wf
- ② Env wf
- ③ Req wf
- ④ Design wf
- ⑤ Imp wf
- ⑥ Ass wf
- ⑦ Deliv wf

Checkpoints

- ① major checkpoints - system wide events
- ② life cycle obj milestone (end of unique phase)
- ③ life cycle subobj milestones (elaboration phase) admin stakeholders
- ④ Initial operation capability milestone. Arch shown task
- ⑤ Product Release Milestone: (const phase) Run Quality
(transition phase) Compliance

Minor checkpoints

definition side pts with disruption



B

Quality

Better communication

ARCHITECTURE

Scalability
flexibility

Reusability



cost
efficiency



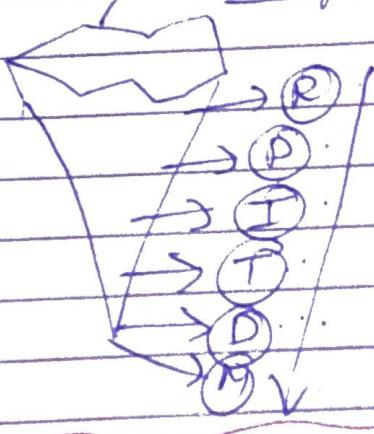
Maintainability



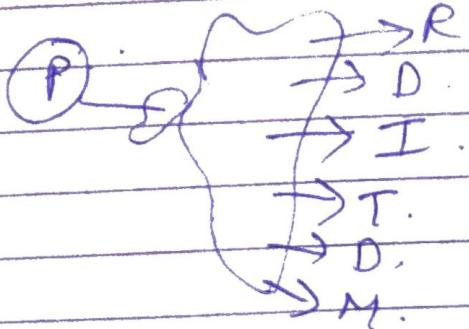
Q

Imp of S/W Architec

{ Artifact sets }



Q



Current state of
Plans, Revs the Prod
Services
Milestones

Key points Reusable

- 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 Maintenance & Monitoring

- ⑭ Improvement - effort
- ⑮ Optimisation - Resource
- 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 Reused
- 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
- ㉜ analysing
- ㉝ recommending
- ㉞ constraints

- ㉙ feedback
- ㉚ project lifecycle
- ㉛ Reliability

- ㉛ M - Monitor
- ㉜ Maintain
- ㉝ Motiv
- ㉞ Measurement

- ㉟ Expertise
- ㉛ Benchmarking

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

- (48) timelines
- (49) schedules
- (50) budgets
- (51) contingencies
- (52) dependencies
- (523)

- (50) continuous improvement
- (8) changing circumstances

- (23) productivity
- (59) flexibility
- (55) does
- (66) execution

Levels

- Initial

Managed

Refined

Quantitative Managed

Optimizing

- (59) training
- (60) Align with Business Goals
- (61) follow up
- (62) evaluation
- (63) Action
- (64) Report
- (65) Assess
- (66) preparation
- (67) leadership

- (68) focus
- (69) standardisation
- (70) innovation
- (71) High performance culture
- (72) prioritize
- (73) iterative process
- (74) Review
- (75) Root cause
- (76) QA

- (77) scope
- (78) Requirements
- (79) foundation