SQA (Sw Quality assurance)

(Session-1)

SQA addresses global challenge of improvement of sw Quality

Standards:

+ ways to maximize performance managers & emp left to themselves to decide on how to improve

they face prblms like:

- ↑ pressure
- ↑ size & complexity
- ↑ requirements
- subcontracting & outsourcing
- distributed work teams
- ever changing platforms & techs

Software Quality.

- Sw quality fundamentals
  - sw eng culture & ethics
  - Value & cost of Quality
  - Models & Quality chars
  - sw quality improvement
  - sw safety.
- sw quality management Process
  - sw Quality assurance
  - Verificatn & Validatn
  - Reviews & audits.
- Practical Considerations.
  - sw quality req
  - defect charctrizatn
  - sw quality management techniques
  - sw quality measurement.
- sw quality tools

- Sw found in embedded sys is called microcode (or) firmware

↓↓

present in Commercial mass marked prods & controls machines & devices used in daily lives.

Firmware:

Combo of Hw device + Comp instructions (or) Comp data that reside as read-only sw on Hw device

Sw Errors, Defects & failures -

- System crash
- designer made an error
- defect in test plan
- bug - breakdown
- problem - failure.

Terminology of sw defects

Error (inserted by human)	undetected error (defect)	Executed defect (failure)

→ Sw defect injection phase [ppt].

Failure: (crash/breakdown) termination of ability of Component to fully / partial perform a function.

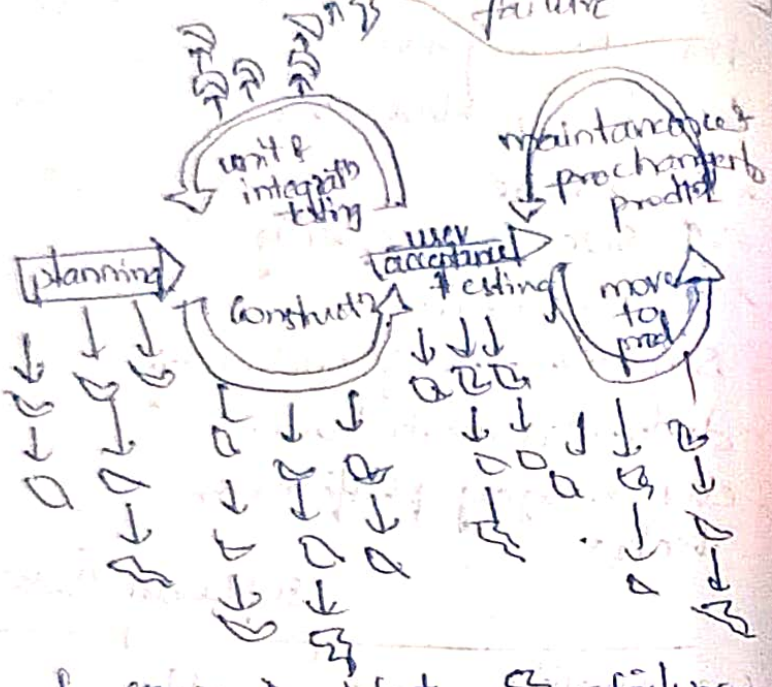
- Original failures lies in defect hiden.

Defects - human errors not detected during dev, QA / testing.

Sw err

error - found in docs, src code instructions. execution (or) in life Cycle of sys

Error (ISO 24765) (person made) → Fault (ISO 24765) (creates fault) → failure (ISO 25010) Chain to failure [ISO 11179]



b- error △- defects ≈ failures.

Cases [refer to ppt].

Dev Life Cycle:

Reqanalysis, design, coding, integration, testing, installatn & support for acceptance of sw prod

Depending on business model, You will have to allow for varying degrees of effort in identifying & Correcting defects

eg: Airbus, boeing, Bombardier & Embraer shd identify & cred defects before we onboarded them.

Research studies Conclusion

- Scope of most defects is limited & easy to correct.
- Many defects occur outside of coding activity.
- Poor understanding of design
- good idea to measure no. & Origin of defects in org to set targets for improvements.

Software Quality:

Conformance to established sw req.

The degree to which a sw prod meets established req.

Software Quality Assurance

Systematic applicatn of scientific & technological knowledge, methods & exp for design implementatn, testing & doctn of sw.

[refer ppt for other def].

SQA shd develop classification of causes of sw error by category:

1. problems in defining req.
2. maintaining effective comm bw client & dev.
3. deviations from specifications.
4. archi & design errors.
5. Coding errors.
6. Non-compliance w current process / procedures.
7. Inadequate reviews & tests
8. documentation errors.

SQA elements

- plan quality aspects of a prod/service
- systematic activities throughout the sw life cycle.
- set up Quality policy & Continuous improvement.
- demonstrate level of Quality reached
- " " " " defined for proj

Business model: describes the rationale of how an Org creates, delivers & Captures value.

Choice of sw practices

Success factors foster sw quality	factors that may adversely affect SQA
- SQA techniques	- lack of coherence bw SQA tech & env factors
- clear terminology	- confusing tech.
- error sources understanding	- lack of understanding
- SWEBOK as a guide for SQA	- ignorance w Published SQA tech

SQA Vs SQ Control

Quality Control: activities designed to evaluate quality a dev prod

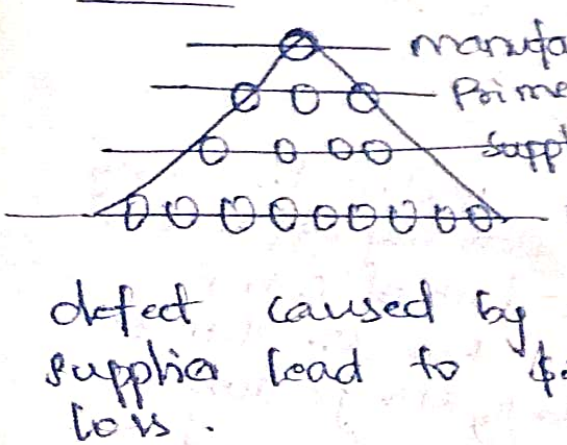
Obj of QA is to minimize cost of guaranteeing quality by Variety of activities in Various Stages.

QA - reduces rate of prods that do not qualify for shipment & cost of guaranteeing

Obj of SQA activities:

1. Sw dev (process - oriented):
   - Conform to functional tech req
   - Conform to managerial scheduling & budget req.
   - initiating & managing SQA activities
2. Sw maintenance (prod-oriented):
   - main-activities will conform to functional tech req.
   - main activities : a to managerial scheduling & budget req.
   - Initiating & managing SQA

Quality Culture:



defect caused by a 3rd level supplier lead to $200 million loss.

Cost of Quality:

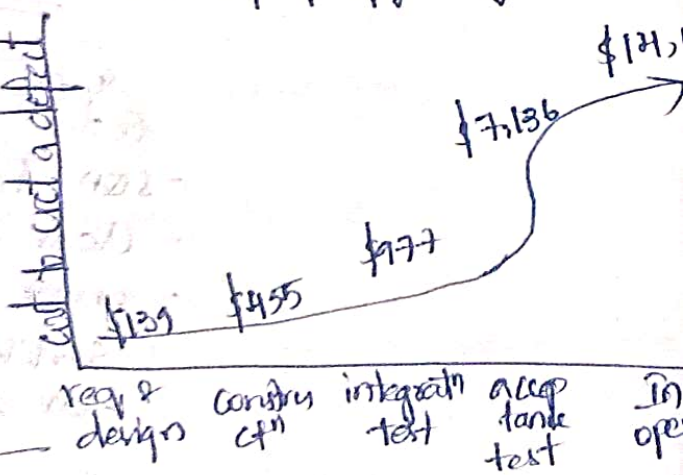
- resistance of to implementing Q is percepn of high cost -
- SWE responsible for informing admins of risks that comp takes not fully committed to quality of sw.
- identify cost of Non-quality
- Identify potential savings by studying prblms caused by sw.

Costs of proj:

1. Implementation cost
2. prevention "
3. Appraisal "
4. cost associated c failures / anomalies -
   - to prevent occurence of errors
   - Verifying prod during dev process steps & monitoring it.

Quality cost = Prevention cost + appraisal costs + internal & external failure cost + Warranty claims & loss of reputation costs.

cost of propgating error.



- Intro, standards, defects, failures ✓
- SQA, quality cntd. ✓
- factors fosters SQ & factors effect SQ ✓
- cost of proj, Calculatns quality cultur principles
- Principles for assuring a quality-driven culture ✓
- Quality perspective McCall, IEEE1601, ISO 25000
- Def, Type of requirements characteristics
- Process
- standards (ISO 9001, ISO/IEC 90003, ISO/IEC/IEEE 12207, IEEE 730)

- Unit testing, Integrat° testing, system testing.
- Test methodology, Planning, Designing, Performing.
- Test case eg.
- Automated testing Process, Types, Test.

- Overview of MIL, ISO, CMM; Fm
- Models, Prod operatn factors, Prod revision factors, Prod Transitn factors →
- Reliability
  Usability
  Maintainability
  Other dm →
- Evans & Marciniak factor model, Deutsh & willis factor model.
- key characteristics, Sw testing strategy
- Def Tech.
- Black box testing, white-box test, boundary value analysis, equivalence partitioning.

SQA:

def:
- addresses global challenge of improvement of SQ.
- Provides an overview of SQA practices for cust, mana, auditors, suppliers & personnel responsible for sw projects, dev, maintenance & sw services.

Standards - define ways to ↑ perf & how to practically improve situatns.
- ↑ Pressure to delives Qual prods
- ↑ Size & Complexity of systems
- ↑ req to met standards
- Subcontracting & Outsourcing
- distributed work teams
- ever changing platforms & tech.

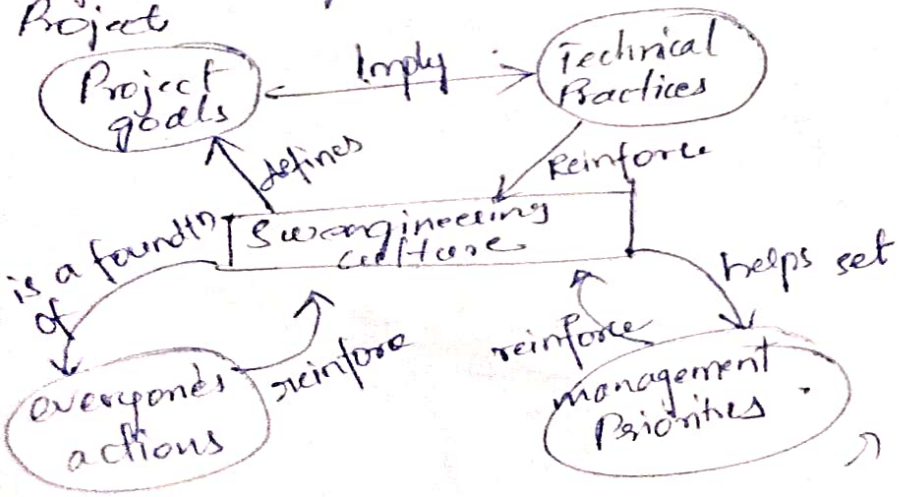
Software Quality

- SQ Fundamentals
  - Sw org culture & ethics
  - Value & cost of quality
  - models & quality characteristics
  - sw Quality improvement
  - sw safety
- sw management Processes
  - sw assurance
  - Verificatn & Validatn
  - Reviews & audits
- Ptatical Consi-derations
  - SQ req
  - Defect characteriz
  - SQ manage tech
  - SQ measuremen
- SQ to

Quality Culture:

Human & culture
Cbelif, art, morals laws...
- & ~~Intst~~ interactn bw sf culture of an org & software engineers & its Project

Healthy culture:
- Personal commitment of each dev
- commitment to org by manager
- " of all team mem.



14 Cultural Principles in SE:

1. never let your boss / client cause you to do poor work.
2. ppl must feel their work is appreciated
3. Continuing educatn is respon of every learn ment
4. Participatn of client is most critical factor of SQ.
5. Ur greatest challenge is to share vision of final prod c client
6. Continuous impro in sw dev is possible & essential.
7. sw dev procedures can help establish common culture of best practices
8. quality is no.1 priority
9. Ensure that it's a peer, not a client who find defect.
10. Key to SQ is to go through all dev steps except coding. - coding shd be done once.
11. controlling error reports is essential to quality
12. If u measure what u do, u can do it better
13. Do what seems reasonable, do not base yourself on dogma.
14. You can't everything at same time, identify changes that reap most benefits & start to apply them as of nxt monday.

Sw Eng code of Ethics:

- dev by Institute of Electrical & Electronics Engineers (IEEE) Comp Society & Associatn for Computing Machinery (ACM).

8 principles of IEEE sw eng code of ethics:

1. The public - SE's shall act consistently c public intrest
2. client & Employer - u act in a manner & which is best intrests for client & employer
3. Product - u ensure products are related
4. Judgment - maintain integrity & independence in their Judgement
5. Management - managers & leades promote ethical approach of manag.
6. Proffession - advance integrity & reputatn of prof
7. Colleagues - shd be fair & supportive to colbagues
8. Self - participate in lifelong learning.

Role of SQA in sdlc:

- Planning (meet all quality req like Scope, budget, time, compitance)
- Design
- Implementation
- Testing
- Deployment
- Maintenance

identify aspects of design that cause problems

implementatn:
- Code reviews
- Sys Integratn testing
- user acceptance v

Testing -
- functionality, usability, Perfc, reliability & Compilance

Depln
- ensure all are Properly implemented, tested & deployed.

- Maintenance.
- Verify sw updates, changes testing
- follow up c cust
- daumnent changes.
- Invest in QA for reliable & bug free.

Standardizing SQA:

Requirements:

RFQ (req for quote)
RFP (req for proposal doc)
SOW (statement of work)
SRS (sw req specificatn)
SRD (sw req doct)
using this extracts need, for below:

-ISO 24765
unctional req: a func sys must be able to perform.
on - Functional req: ISO 24765
sw req describes how to do
rformance req: IEEE Std. 1220™-2005
ow well fun mus be accomplished

Software Quality Models:

5 Quality perspectives described by Garvin:

1. Transcendental approach to qualit
- "although I can't define quality - I know it when i see it"
- quality is a personal & indiv exp hence takes time for users to see it.

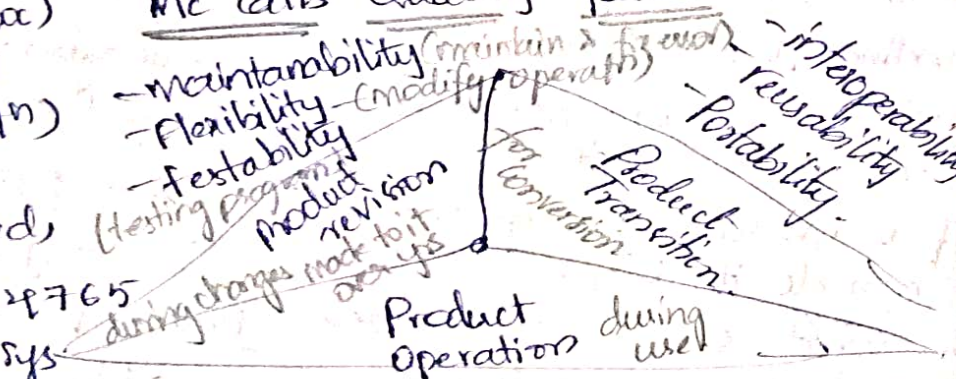
2. User-based approach:
- sw performs as expected from user's perspective.

3. Manufacturing-based appr:
- complying c specifications, illustrated by many docs on quality.

4. Product-based app:
- involves internal view of prod

5. Value-based app:
- eliminating all activities that do not add value.

Mc Calls Quality factors:



Correctness → traceability, completeness, consistency
Reliability → accuracy, error tolerance

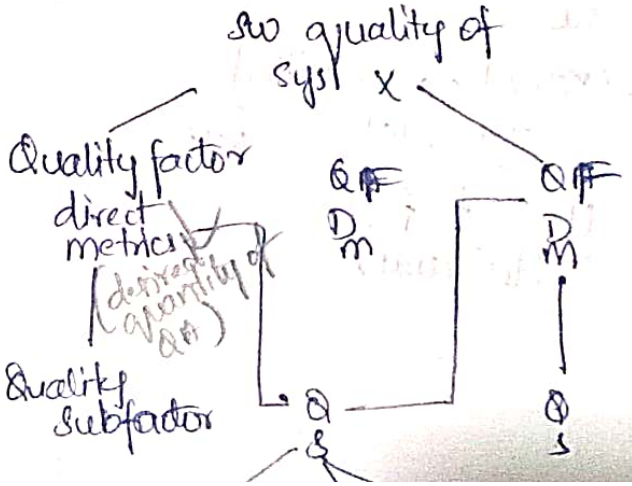
Efficiency → execution efficiency, storage u

Integrity → access cntrl, access audit

usability → operability, testing, communicatn

Mc Call proposes scale of 0 to 10 for evaluatn.

The First Standardized Model:
IEEE 1061
- fm for measuring sw quality that allows for establishment & identificatn of sw measures based on QA req to implement analyze & Validate



for * Eq : sum & $

Quality Measures:

1. Sw Program acquisition:
- contractual commitment regarding Quality obj for client users

2. Sw dev:
quality char's on which designers & developers must work.

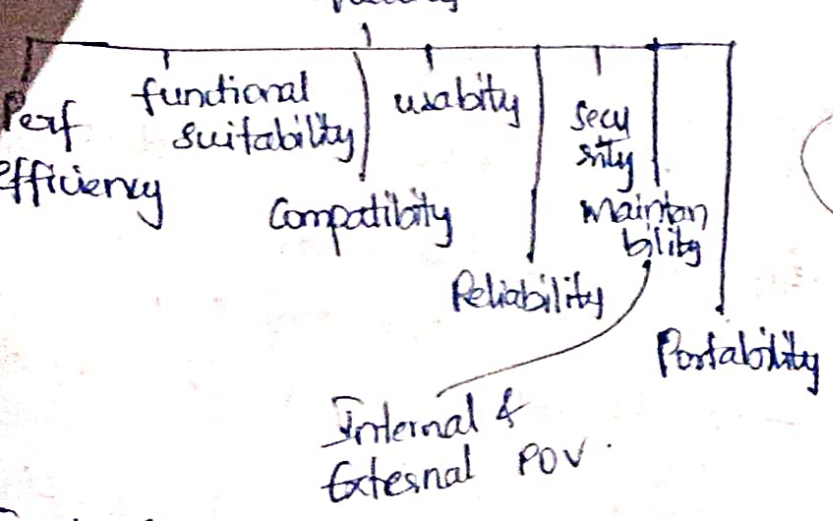
3. QA / Q. cntrl / audit:
- to enable those outside dev team to enable quality

4. Maintainence:

5. client [User]: allow them to state

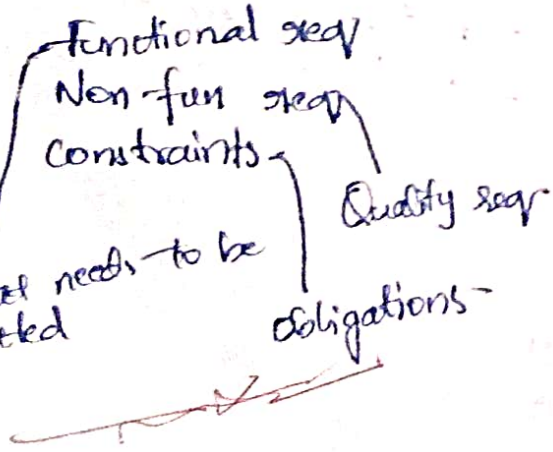
Steps produced by under IEEE 1061 (IEE 986) std.
- identify list of non-functional Quality req
- everyone involved
- List & make sure to resolve Conflicts
- quantify each quality factor
- have measures & thresholds approved
- perform cost benefit study
- implement measurement method
- Analyze results
- Validate measures.

Cias standardized model:
ISO 25000 set of standards.
1. Asses quality of dev process
2. Asses quality of final prod.
4 steps:
1. Set & reqv
2. Establish quality model
3. Define quality measures
4. Conduct Evaluations.
8 attributes.



Evaluating in ISO 25010
qu model
chars
subchars
metrics.

eak specifications into
-gather
Prioritize
analyze
describe
Specify.



chars to measure quality of reqv
Necessary, unambiguous, Concise, coherent, complete, Asse Accessible, Verifiable

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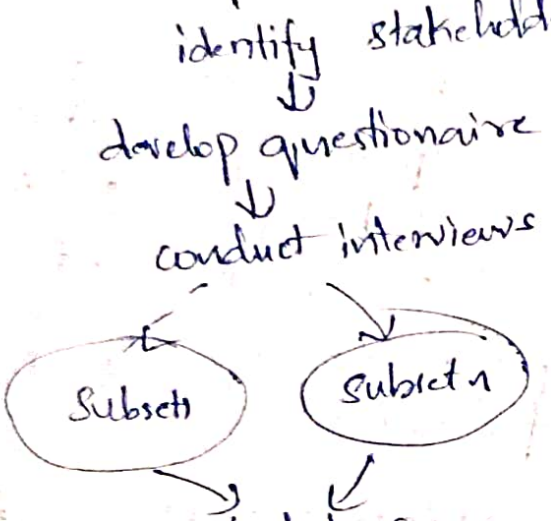
Specifying Quality reqv:
The process



* Evaluatn of functional capacity of sw

$$\%E = \left(\frac{\text{no. of functionalities requested}}{\text{no. of fun delivered}}\right) \times 100.$$

Standard:

- A set of mandatory reqts established by consensus & maintained by a recognized body to prescribe a disciplined & uniform approach, or to specify a prod i respect to mandatory conventions & practis

4 principles for dev of ISO standards:

- ISO standards meet a market need
- " " are based on worldwide expertise.
- " " are result of multi-stakeholder process
- " " are based on consensus.

Standards

IEEE
ISO (inter Org of for standardizatn)
CMM (Capability maturity model).

Standards related to QA

ISO 9000
ISO 900)
↳ family includes

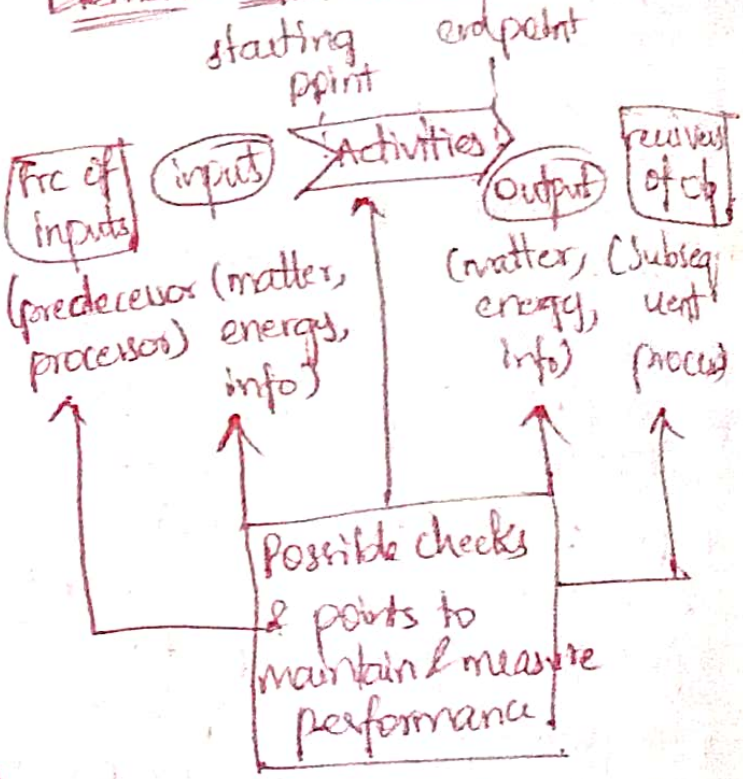
ISO 90001:2015 - sets. reqt of Q m^gt sys
ISO 9000:2015 : Covers basic concepts & lang -
ISO 9004:2009 : focus on how to mak qms ↑ efficient & effective.
ISO 19011:2011 : sets out guidance for internal & external audits.

7 Comp of ISO 9001

- cust focus
- Leadership
- Involvement of ppl
- Process approach
- Sys app to management
- factual app to decision making
- mutually beneficial supplier relationships.

follows PDCA Cycle.
(plan-Do-check-Act)

Elements of a process



ISO/IEC 90003 std.
- International Electrotechnical Commission.
- acquiring, supplying, developing using & maintaining sw.

ISO/IEC/IEEE 12207 - std.
- common fm of sw life cycle proces.

ISO 12207-
A set of processes
- 2 agreement
- 6 org policies
- 8 process
- 14 tech proces

} skipped

IEEE 730.
- guidance for SQA acti of prods / ses.
- Implementatn of SQA pro, prod assurance & process assurance.

eg: dig - skipped

Prod assurance activities	Process assurance activities
- evaluate plans for compliance to contracts, stds & requirn	- compliance of process & plans
- v prod for compliance to established req	- v env of compliance
- v prod for acceptability	- a subcontractor pro for compliance
- v compliance of prod support	- measure process
- measure prdts	- assess skills knowledge of personal

Capability Maturity models (CMM)
- improve & refine sw dev proces
- analyses approach & tech followed by org
- guidelines to enhance maturing
- imp prod-qual.
- 2 Versions.
  1. Initial staged Version
  2. Continuous Version.

CMM model for sys eng is CMMI-DEV.
- imp dev & evaluate maturity
- evaluates level of maturity of 5-level scale.

Other 2 CMM models
CMMI-SVC (services)
CMMI-ACQ (acquistn)
(Guidelines for org).

- for each level of maturity set of process & req it shd be meet are defined.

5 maturity levels in CMMI-Dev.

1- Initial
- Org as chas by tendency to overcommit, abandon process in time of crisis unable to repeat success

Cap 2. Managed.
- manages acc to document plans.

Proces areas:
Req managing,
Proj planning, monitoring & cntrl
Supplies agreement mgt
measurent & analysis
Proc & prod qa

3. Defined:
- Processes are well understood & described in standards, tools, procs, methods.
Process areas:
- req dev - tech soln
- Prod integratn - verificatn
- Validatn - Org process focus
- risk ma - u u def
- decision analysis

4. Quantitatively managed:
Process areas:
- Org process performance
- Quan Proj management

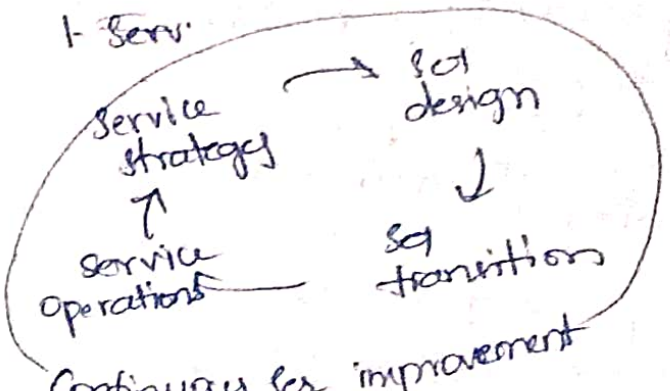
5. Optimizing:
impro pro based on quan under of its busi obj & perf needs.
Process areas:
- Org perf mana
- Causal analysis & resolutn

(dig)
& quality productivity increases from level 1 to level 5
risk rework

ITIL fm:
- Info Tech & infrastructure Library.
- fm for ITSM (IT Service management) align IT services to business needs

IT Services by ITIL
1. Selecting
2. Planning
3. Delivering
4. maintaining.

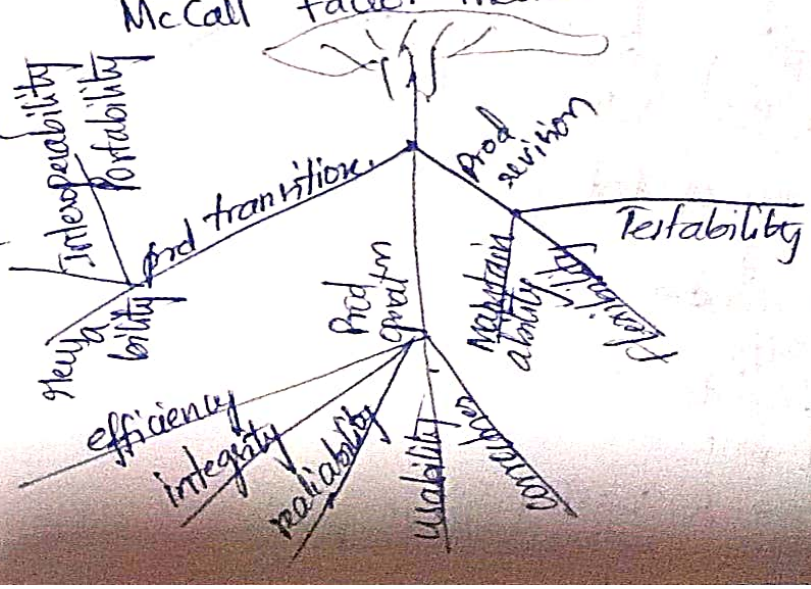
ITIL Service Lifecycle



Process:
- service level management
- financial ma of IT ser
- Capacity ma
- IT Ser continuity man
- availability mana.
- User support
- Provision of ser
- appln man
- Ser

Advs:
↓ cost, ↑ Quality of Ser, ↑ bus productivity, ↑ ROI, greater cust satisfactn, ↑ resrc utilizatn

McCall Factor model:



Alternative models.
- Both " " excludes testability
1. The Evans & Marchiniak factor model (12)
2. The Deutsch and willis factor model. (15)

Testing
- Black box testing
- white box testing

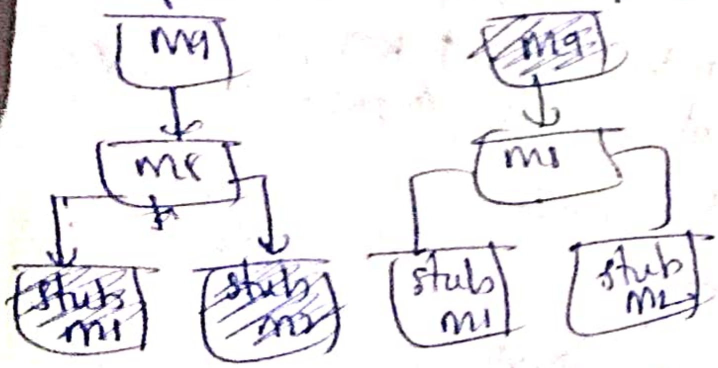
Verifiability
Manao Expandability } Both models

Managability
Safety
Survivability } only Deutsch & willis.

— x —

Testing - a process of executing a Pgm c̄ the intentn of finding errors.
- Formal
- specialized testing team
- running pdo programs
- approved test pros
- " " cases

topdown bottom up testing



5 levels of testing.
Debug
Demonstrate
Verify
Validate
Prevent.

Swtesting = sw Verification + sw Validatn