AN INTRODUCTION

TO

INTERNATIONAL STANDARD

ISO/IEC 12207

SOFTWARE LIFE CYCLE PROCESSES

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FAA, WASHINGTON, DC
April 26, 1999

ISO/IEC 12207
PURPOSE

- **To establish a common framework for the life cycle of software**

  - To foster mutual understanding among business parties
  - To acquire, supply, develop, operate, and maintain software
  - To manage, control, and improve the framework.

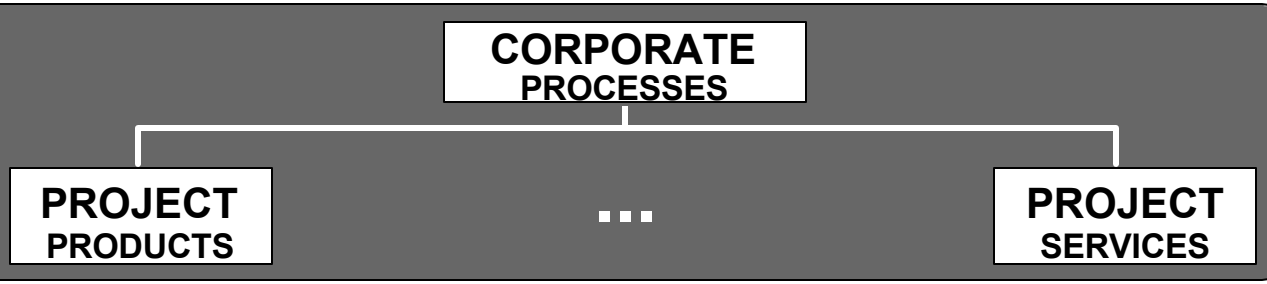
For World Trade in software:
"… facilitating international exchange of goods and services …"

ISO/IEC 12207
SCOPE

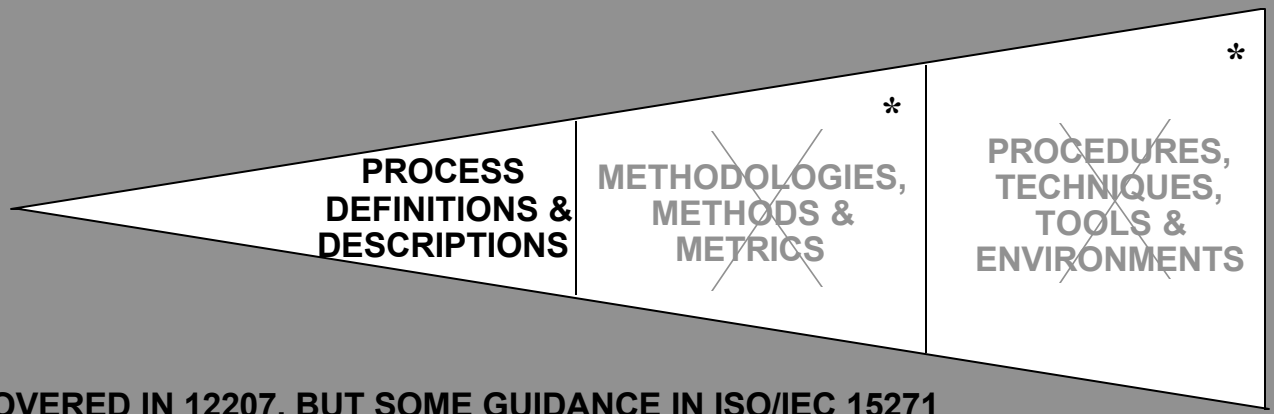
LIFE CYCLE: CRADLE ... GRAVE

STAKEHOLDERS: ACQUIRERS , SUPPLIERS , USERS, ...

APPLICATION:



DETAILS:



* NOT COVERED IN 12207, BUT SOME GUIDANCE IN ISO/IEC 15271

TOPICS

1. **BACKGROUND**
   - ISO and IEC
   - History of ISO/IEC 12207
2. **BASIC CONCEPTS**
3. **THE PROCESSES**
4. **APPLICATION**
5. **RELATED AREAS**
6. **SUMMARY**
7. **FOR YOUR INFORMATION**

BACKGROUND - I

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

- **ESTABLISHED:** 1947
- **OBJECT:** Promote the development of standardization ... in the world
  ... to facilitating international exchange of goods and services
- **MEMBERS:** 87 countries (1994)
- **TECHNICAL COMMITTEES (TCs):** Carry out technical work
- **TCs THAT MAY IMPACT SOFTWARE ENGINEERING:**
  - TC 10: Technical Drawings
  - TC 20: Space and aircraft vehicles
  - TC 46: Information and documentation
  - TC 145: Graphical symbols
  - TC 154: Documents and data elements in administration, commerce and industry
  - TC 159: Ergonomics
  - TC 176: Quality management and quality assurance
  - TC 184: Industrial automation systems

BACKGROUND - II

IEC

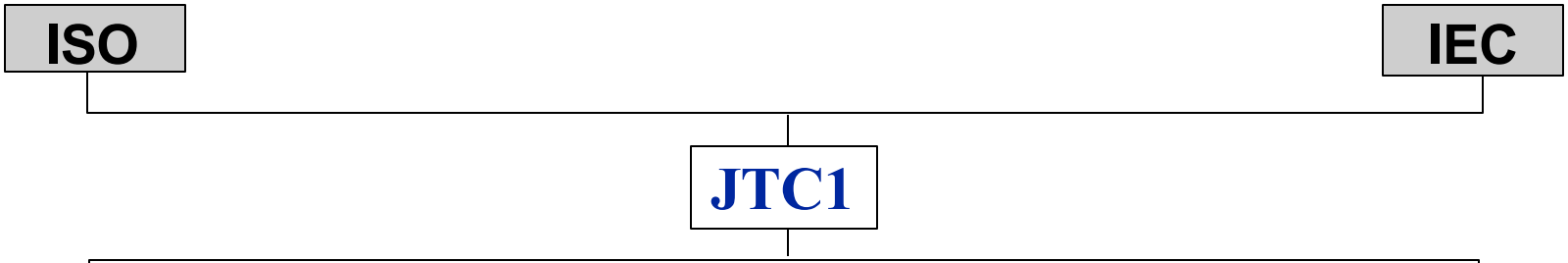
INTERNATIONAL ELECTROTECHNICAL COMMISSION

- **ESTABLISHED:** 1906
- **OBJECT:** Standardization in electrical and electronic engineering fields
- **TECHNICAL COMMITTEES (TCs):**
  - Carry out technical work
- **TCs THAT MAY IMPACT SOFTWARE ENGINEERING:**
  - TC 45: Nuclear instrumentation
  - TC 56: Dependability and maintainability
  - TC 65: Industrial process measurement/control

BACKGROUND - III

JOINT TECHNICAL COMMITTEE 1

INFORMATION TECHNOLOGY



ESTABLISHED: 1987

OBJECT: TO CARRY ON STANDARDIZATION WORK IN INFORMATION TECHNOLOGY

- **SC1 - Vocabulary**
- **SC2 - Character sets & information coding**
- **SC6 - Telecommunications & information exchange between systems**
- **SC7 - Software engineering**
- **SC11 - Flexible magnetic media for digital data interchange**
- **SC14 - Representation of data elements**
- **SC15 - Labeling and file structure**
- **SC17 - Identification cards & related devices**
- **SC18 - Document processing and related communication**
- **SC21 - Information retrieval, transfer & management for OSI**
- **SC22 - Programming languages, their environments & systems software interfaces**
- **SC23 - Optical disk cartridges for information interchange**
- **SC24 - Computer graphics and image processing**
- **SC25 - Interconnection of information technology equipment**
- **SC26 - Microprocessor systems**
- **SC27 - IT security techniques**
- **SC28 - Office equipment**
- **SC29 - Coded representation of picture, audio and multimedia/hypermedia information**

BACKGROUND - IV

SC7
SOFTWARE ENGINEERING

CHAIRMAN: FRANCOIS COALLIER (CANADA)
SECRETARY: JEAN-NORMAND DROUIN (CANADA)

WG 2
SYSTEM SOFTWARE DOCUMENTATION
CONVENER: KEN JOHNSON (UK)

WG 4
TOOLS AND ENVIRONMENT
CONVENER: THOMAS VOLLMAN (USA)

WG 6
EVALUATION & METRICS
CONVENER: MOTOEI AZUMA (JAPAN)

WG 7
LIFE CYCLE MANAGEMENT
CONVENER:

WG 8
SUPPORT OF LIFE CYCLE PROCESSES
CONVENER: STAN MAGEE (USA)

WG 9
SOFTWARE INTEGRITY
CONVENER: DAVID KIANG (CANADA)

WG 10
PROCESS ASSESSMENT
CONVENER: ALEC DORLING (UK)

WG 11
Sw ENGINEERING DATA DEFINITION
CONVENER: PETER EIRICH (USA)

WG 12
FUNCTION SIZE MEASUREMENT
CONVENER: PAMELA MORRIS (AUSTRALIA)

WG 13
Sw PROCESS MEASUREMENT
CONVENER: JOHN McGARRY (USA)

BACKGROUND - V
ISO/IEC 12207

- **SPONSOR:**
  Joint Technical Committee 1 (JTC1) (Information Technology) of International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC)
  - Developer: Subcommittee 7 (SC7) (Software Engineering)

- **HISTORY:**
  - Proposed in June 1988
  - 4 Working Drafts; 2 Committee Drafts; 1 DIS
  - Over 6 years and 17000 person-hours expended
  - Published 1 August 1995

- **PARTICIPANTS:**
  - Countries: Australia, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, Netherlands, Spain, Sweden, UK, USA
  - Convener: James Roberts (USA)
  - Editor: Raghu Singh (USA)

TOPICS

1. BACKGROUND

2. BASIC CONCEPTS
   - Principles and assumptions under 12207 development
   - Concepts for understanding the standard

3. THE PROCESSES

4. APPLICATION

5. RELATED AREAS

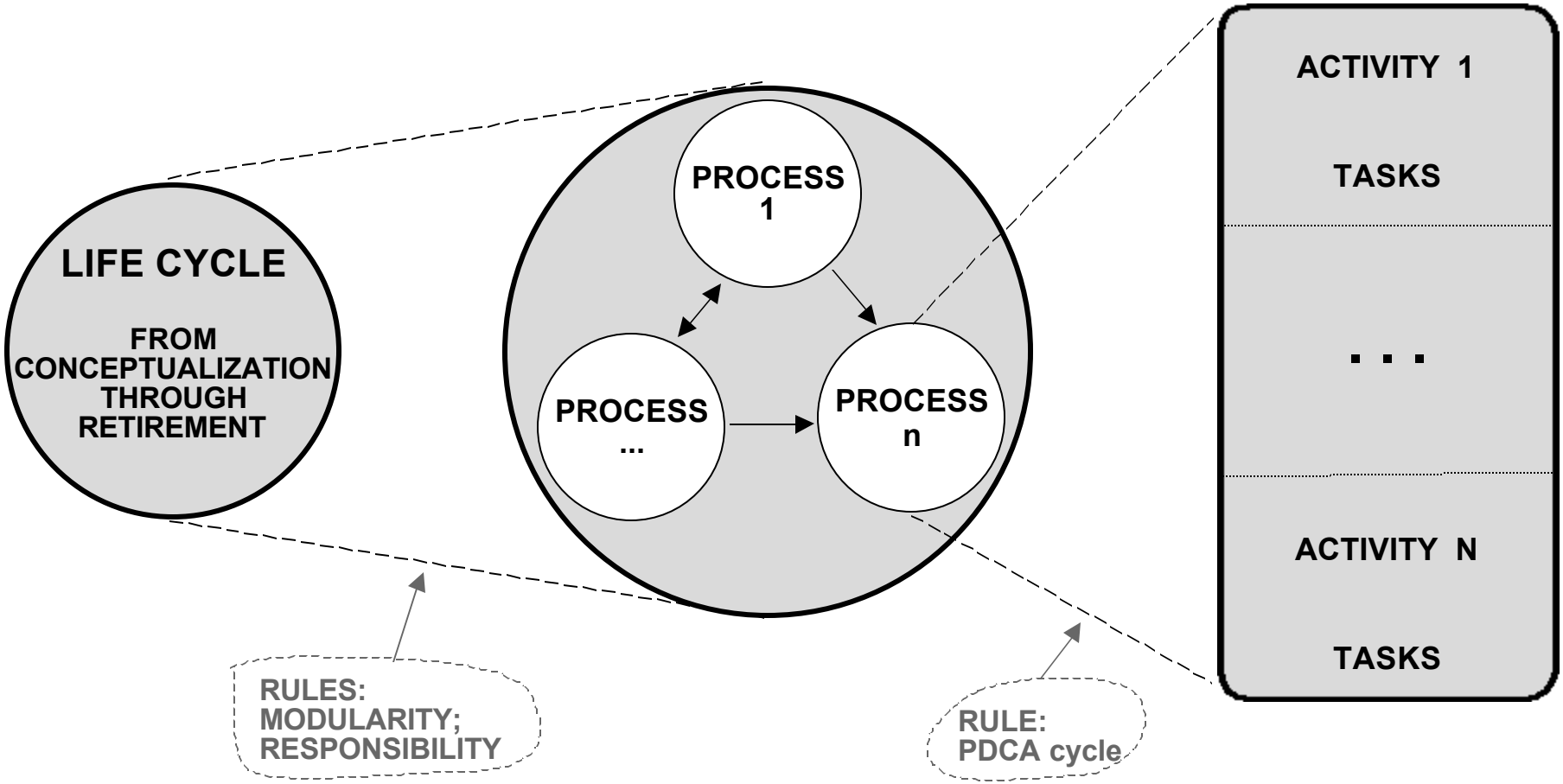
6. SUMMARY

7. FOR YOUR INFORMATION

BASIC CONCEPTS - I
LIFE CYCLE & ITS ARCHITECTURE

- **TITLE OF 12207:** ***Software Life Cycle Processes***
  - Meaning: The processes in the life cycle of software

- **THE ARCHITECTURING OF THE LIFE CYCLE:**



BASIC CONCEPTS - II

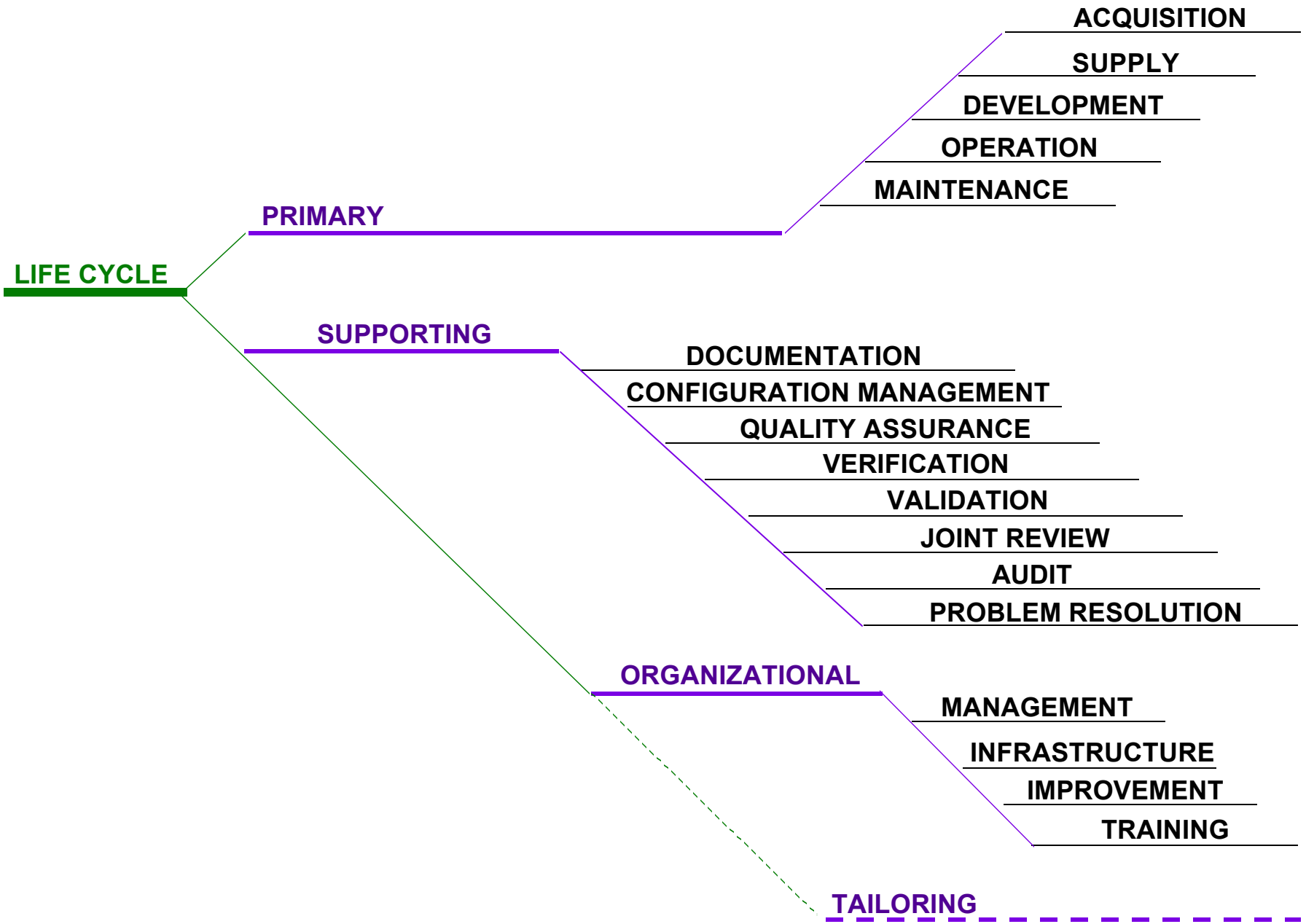
RULES FOR PARTITIONING THE LIFE CYCLE

- **MODULARITY**
  - Cohesion (Functional): Tasks in a process are functionally related.
  - Coupling (Internal): Linkages among the processes be minimal
  - Association:
    - If a function is used by more than one process, then the function becomes a process in itself
    - If Process X is invoked by Process A and Process A only, then Process X belongs to Process A
    - Exception: Only for potential future application.

- **RESPONSIBILITY**
  - Each process is under a responsibility
  - A function whose parts are under different responsibilities shall not be a process
  - Contrast it with a process for a monolithic subject
    - Example: Quality management

- **Note:** The life cycle itself was not partitioned in time, as the life cycle of software follows its parent system's life cycle.

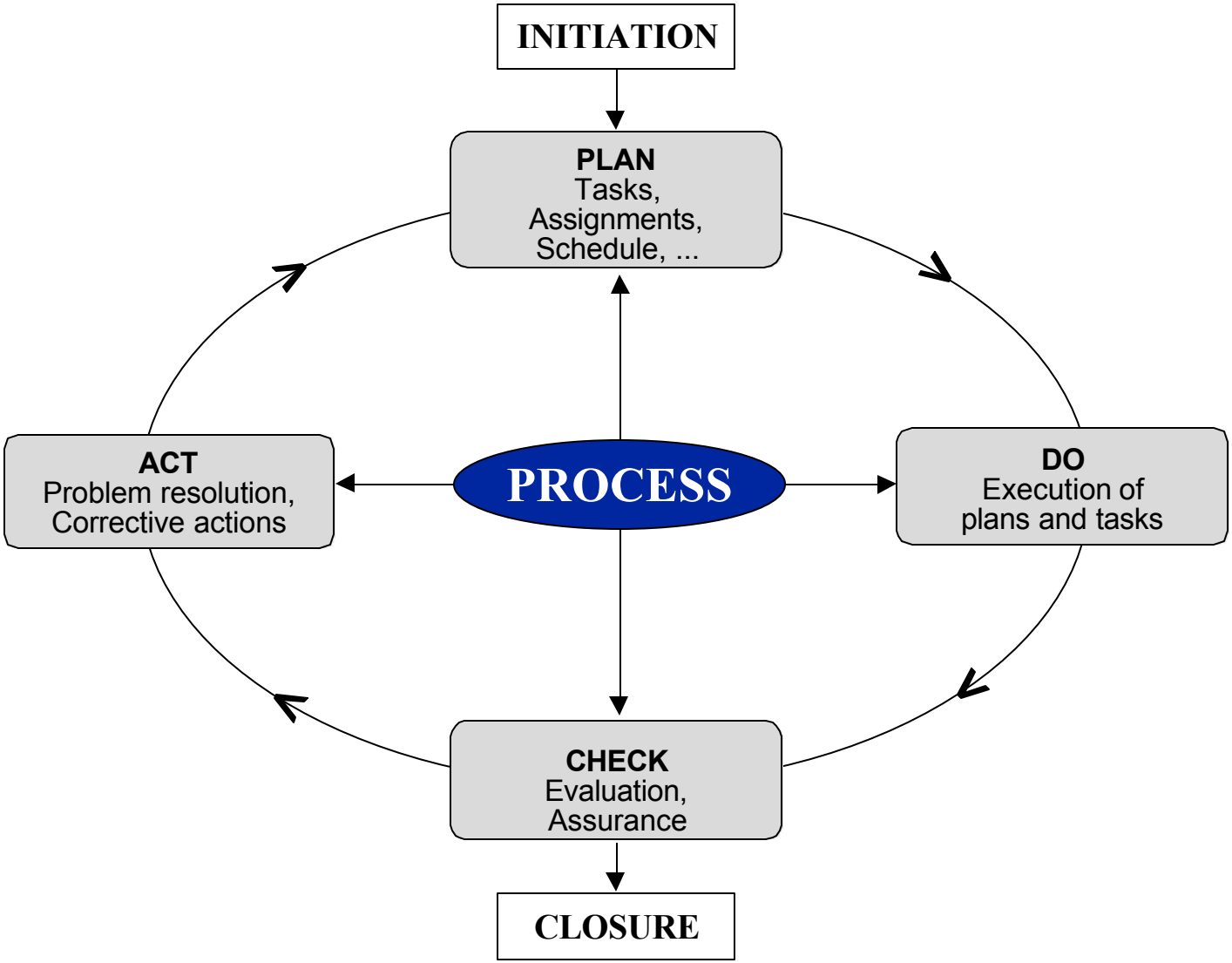
BASIC CONCEPTS - III
THE PROCESS TREE



BASIC CONCEPTS - IV

RULES FOR PARTITIONING A PROCESS

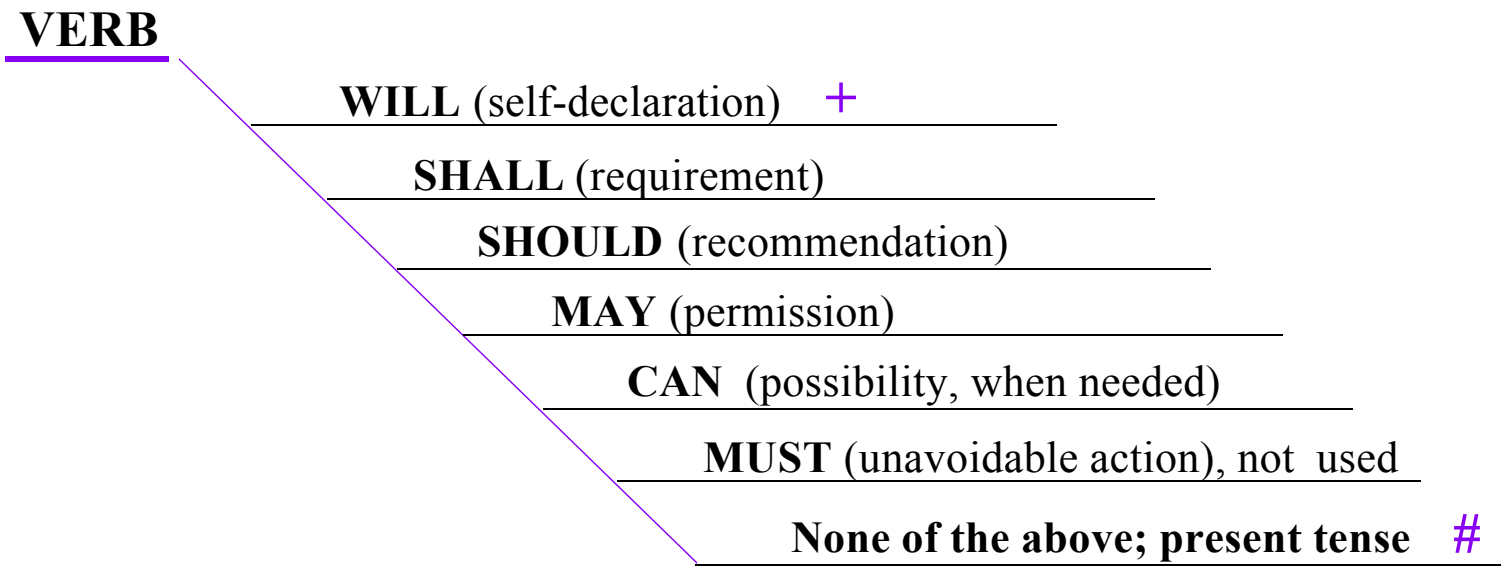
- **A PROCESS IS PARTITIONED INTO PDCA ACTIVITIES**
  - BASED THE PDCA-CYCLE PRINCIPLES



BASIC CONCEPTS - V
ACTIVITY & TASKS

- **AN ACTIVITY IS DIVIDED INTO TASKS, WHICH ARE GROUPED INTO SIMILAR ACTIONS**

- **TASK:**
  - A what-to-do action; not a how-to-do action
  - Verbs used:



\+ Not mentioned in the IEC/ISO Directive.

\# Not a requirement. Used in preamble, assumption, or to complete the context.

BASIC CONCEPTS - VI

- **BASED ON TQM PRINCIPLES**
  - Each party/participant has appropriate responsibility
  - Plan-Do-Check-Act (PDCA) cycle built into processes
  - Consistent with "functional" modularity and internal coupling

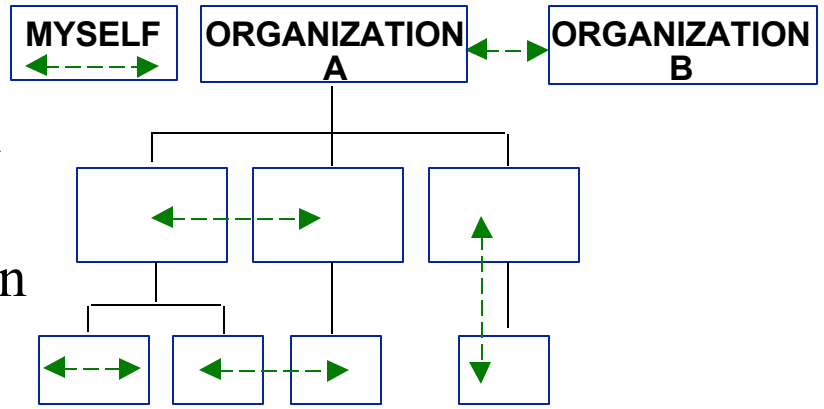
- **ESTABLISHES LINK WITH SYSTEM**
  - System activities are the foundation for software activities
    - Needs analysis, development, operation, maintenance, ...
    - Analysis, design, fabrication, integration, testing, ...
  - Software is treated as a part of the system
    - Necessary system context provided
    - System assigns functions to software
    - Software extracted from, developed within, and integrated back into the system
    - Software personnel participate in system activities

BASIC CONCEPTS - VII

- **ORGANIZATION & PARTY**
  - Organization: An independent body of persons
  - Party: One who enters into an agreement
  - Parties may be from the same or separate organization(s)
  - An organization (party) gets its name from the process it executes, and the name is functional
  - Acquirer executes Acquisition process

- **MULTI ROLES:**
  - A party may have more than one role
  - Example: A supplier with a sub-contractor is both supplier and acquirer.

- **LEVELS OF APPLICATION**
  - By a person as a self-imposed standard
  - By an organization internally
  - Between persons within an organization
  - Between two organizations



BASIC CONCEPTS - VIII

- **RANGE OF AGREEMENT:** From informal to legal contract.
- **LANGUAGE**
  - General: Introductory; to complete the situation/context; ...
  - Agreement: To facilitate self-imposed and contractual use
  - Active voice when party is clearly known
  - Passive voice when party is not clearly known, or when it is better syntactically
- **PROJECT**
  - A project may be solo
  - A project may exist in pre-agreement, agreement, or post-agreement phase, or a combination of the above
  - A project may span full or a part of life cycle
- **DESIGNED FOR ADAPTATION AND TAILORING**
  - Adaptation by an organization
  - Tailoring by a project
  - To fit the needs, size, complexity, cost, schedule, performance

BASIC CONCEPTS - IX
COMPLIANCE & CERTIFICATION

- **COMPLIANCE**

  Absolute level -- Default (IEC/ISO Directive 3, 4.1.2):
  All "shalls" and "wills" are performed.
  - To claim compliance with the Standard.
  - Note that compliance with the full Standard may not be realistic.

  Project level (ISO/IEC 12207, clause 1.4, paragraph 1):
  Parties develop an agreement, with which they comply.
  - The agreement includes plans and tasks from 12207 and elsewhere.
  - Parties perform in accordance with the agreement.
  - 12207 itself then stays on the sidelines, its purpose served.

  Organizational level (ISO/IEC 12207, clause 1.4, paragraph 2):
  Organization declares public a set of clauses with which its suppliers comply.

- **CERTIFICATION**
  - Not addressed in 12207
  - Note that certifying an organization to the full Standard may not be realistic.

BASIC CONCEPTS - X
WHAT 12207 IS NOT

- **NOT PRESCRIPTIVE; NO HOW-TOs**
  - Responsive to evolving technologies
  - No interference in technical decision-making
- **NOT A STANDARD FOR METHODS, TECHNIQUES & MODELS:**
  - Does not prescribe management and engineering methods
  - Does not prescribe computer languages
  - Does not prescribe software engineering environments
  - Does not prescribe life-cycle or development models
    - Waterfall; incremental; evolutionary; Spiral, reengineering, ...
- **NOT A STANDARD FOR PRODUCTS**
  - Requires specific output groups be documented
  - But prescribes no formats, explicit contents, or media
  - *An organization's product standards usable with 12207*
- **NOT A STANDARD FOR METRICS**
  - Many tasks need metrics and indicators
  - But prescribes no specific metrics/indicators
  - References ISO/IEC 9126 for guidance

BASIC CONCEPTS - XI

- **A MANAGEMENT COMPLEMENT**
  - 12207 complements institutionalized management
  - 12207 is not a substitute for systematic, disciplined management
  - It provides a powerful and complete but flexible set of building blocks of software life cycle for projects and organizations to use as appropriate and effective

- **PREREQUISITES TO USING THE STANDARD:**
  - Understanding of 12207
  - Organization's policies
  - Project's requirements and characteristics
  - Project's life-cycle model(s)
  - Institutionalization of methods, procedures, techniques, tools and environment for performing the 12207 and other tasks
  - Trained personnel

Instill life cycle view!

BASIC CONCEPTS - XII
MAJOR ISSUES DURING 12207 DEVELOPMENT

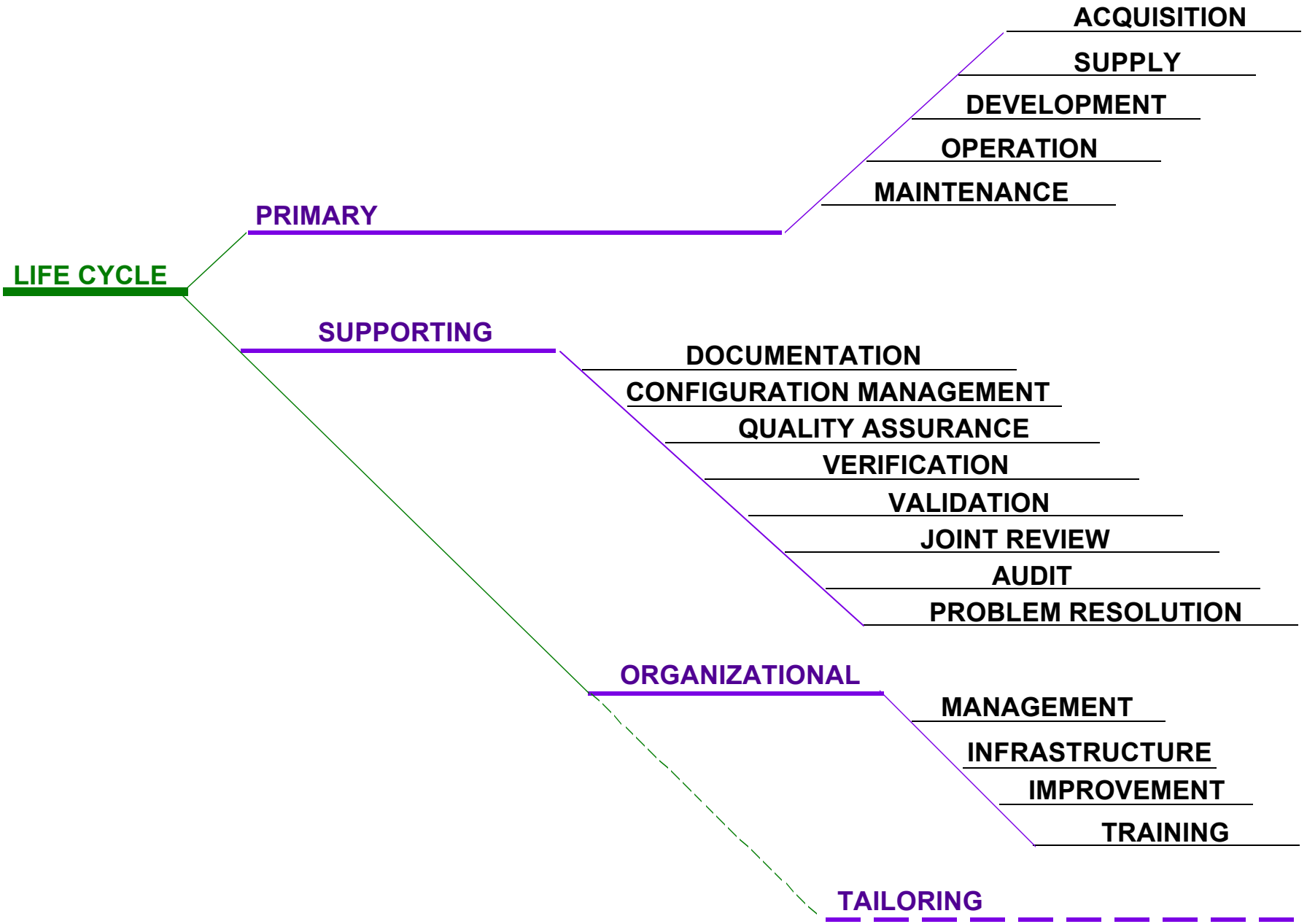
- **ARCHITECTURE:**
  - Based on responsibilities; fix it for the parties? [U]
    - Acquisition, development, maintenance, ...
  - Monolithic topics; let the parties figure out?
    - Management, contracting, engineering, quality, ...
- **SOFTWARE *v.* SYSTEM:**
  - Include necessary system activities? [U]
  - Only software specific?
- **LANGUAGE OF CLAUSES:**
  - Declarative? [U]
  - Imperative?
- **EVALUATIONS:**
  - Assign evaluations to all parties appropriately? [C]
    - Do some evaluations become duplicative?
  - Place all evaluations under quality control?
- **LEGEND**: U- unanimous; C - consensus

TOPICS

1. BACKGROUND
2. BASIC CONCEPTS
3. THE PROCESSES
   - Introductory material
   - Explanation of the processes and their interactions
   - Coverage of special topics in the processes

   Note: In charts, start at  if shown
4. APPLICATION
5. RELATED AREAS
6. SUMMARY
7. FOR YOUR INFORMATION

THE PROCESS TREE



STATIC VIEW OF A PROCESS
THE LAYOUT

a.b Process name

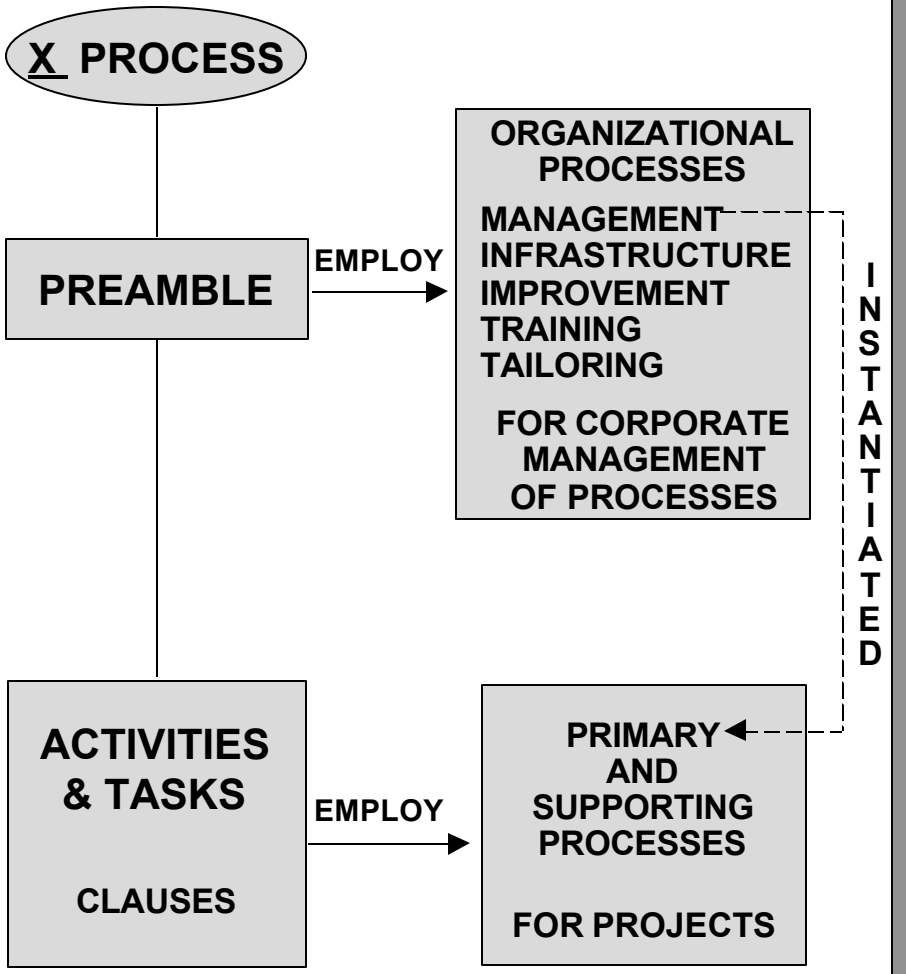
Preamble

- Abstract of the process
- Generic actions at corporate level
- In present tense
- No requirements
- Introduces a list of activities.

Activities & Tasks

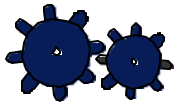
- All with shall, will, should, may, can
- Except 5.1.1.1, 5.2.1.1 (present tense)
  - To complement the context
- For project products and services

a.b.n: Activity n in process a.b
a.b.n.1: Task 1 in activity n, process a.b
...
a.b.n.m: Task m in activity n, process a.b



DYNAMIC VIEW OF PROCESSES

THE WORKINGS



FUNCTION	PROCESS EMPLOYED	OUTPUT
CORPORATE MANAGEMENT OF PROCESSES [NOT OF CORPORATION]	ORGANIZATIONAL PROCESSES → TAILORING PROCESS - FOR ADAPTATION	- INSTITUTIONALIZED PROCESSES - MANAGED PROCESSES - TAILORED/TOOLED PROCESSES FOR PROJECTS
PROJECT MANAGEMENT WITH PROCESSES	PRIMARY PROCESSES → SUPPORTING PROCESSES → TAILORING PROCESS	MANAGED PROJECT

STRATEGY FOR EXPLAINING THE PROCESSES IN THE TUTORIAL

- 12207 BEGINS THE DESCRIPTION OF EACH PRIMARY AND SUPPORTING PROCESS AT THE CORPORATE LEVEL BY INVOKING:
  - MANAGEMENT PROCESS
  - INFRASTRUCTURE PROCESS
  - IMPROVEMENT PROCESS
  - TRAINING PROCESS
  - TAILORING PROCESS

- 12207 CONTINUES WITH THE DESCRIPTION FURTHER AT THE PROJECT LEVEL -- IN ACTIVITIES AND TASKS.

- THIS PRESENTATION, FOR SAKE OF SPACE AND CLARITY, WILL EXPLAIN:
  - FIRST, THE PRIMARY AND SUPPORTING PROCESSES AT PROJECT LEVEL
  - THEN, THE ORGANIZATIONAL PROCESSES AT CORPORATE LEVEL.

REQUIREMENTS

Without requirements, there really is no project.

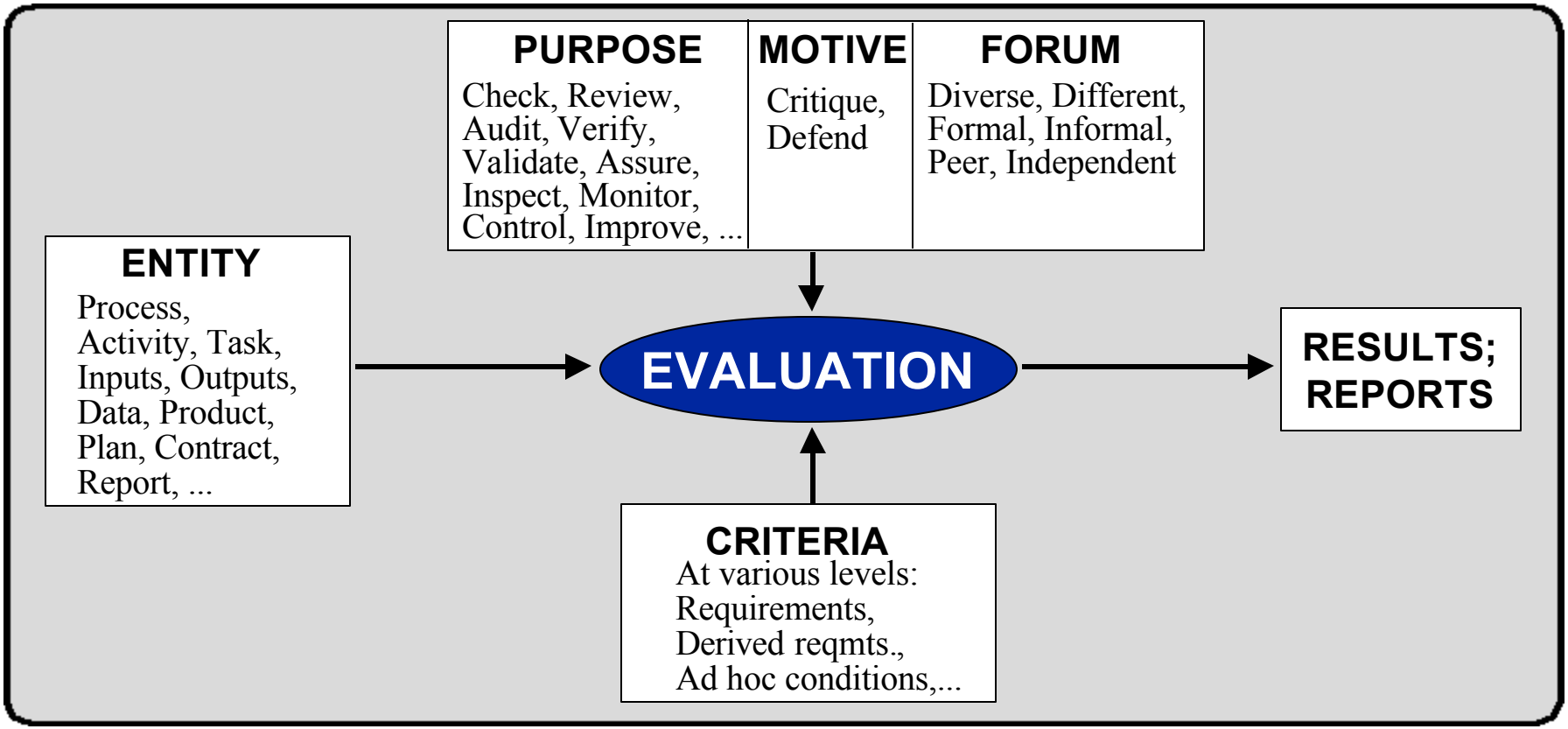
- **REQUIREMENT:**
  - An expectation/demand as a compliance/obligation/agreement
  - Indicated by a "shall" or a "will"
  - The qualifier to a requirement identifies its source and receiver; no qualifier means in local, immediate context
  - May contain constraints on design, interface, test, or development/test/operation/maintenance environment

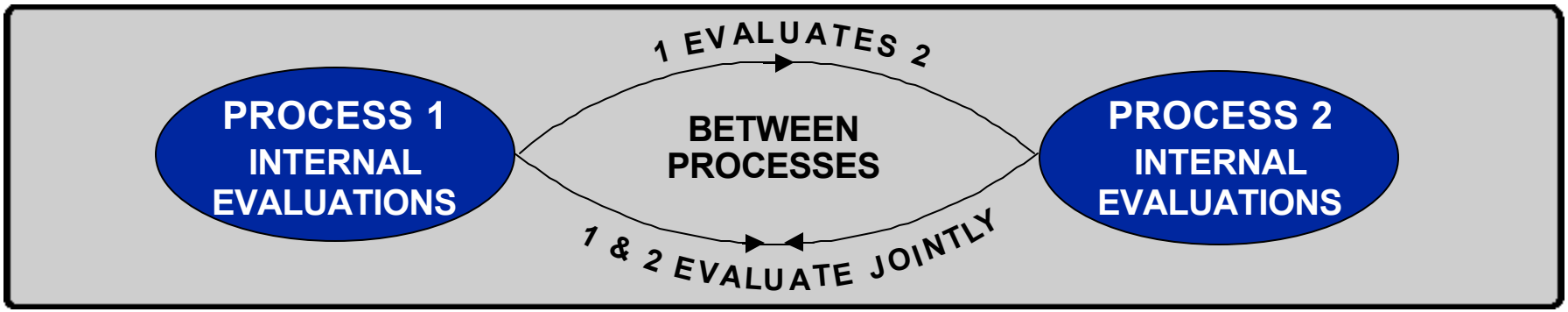
- **SPECIFICATION:**
  - Technical description (form, fit, and function) of a requirement

- **DYNAMICS:**
  - A step may generate requirements for a neighboring or distant step.
  - Requirements/specifications typically change and expand in time.
  - The challenge is managing the changing requirements.

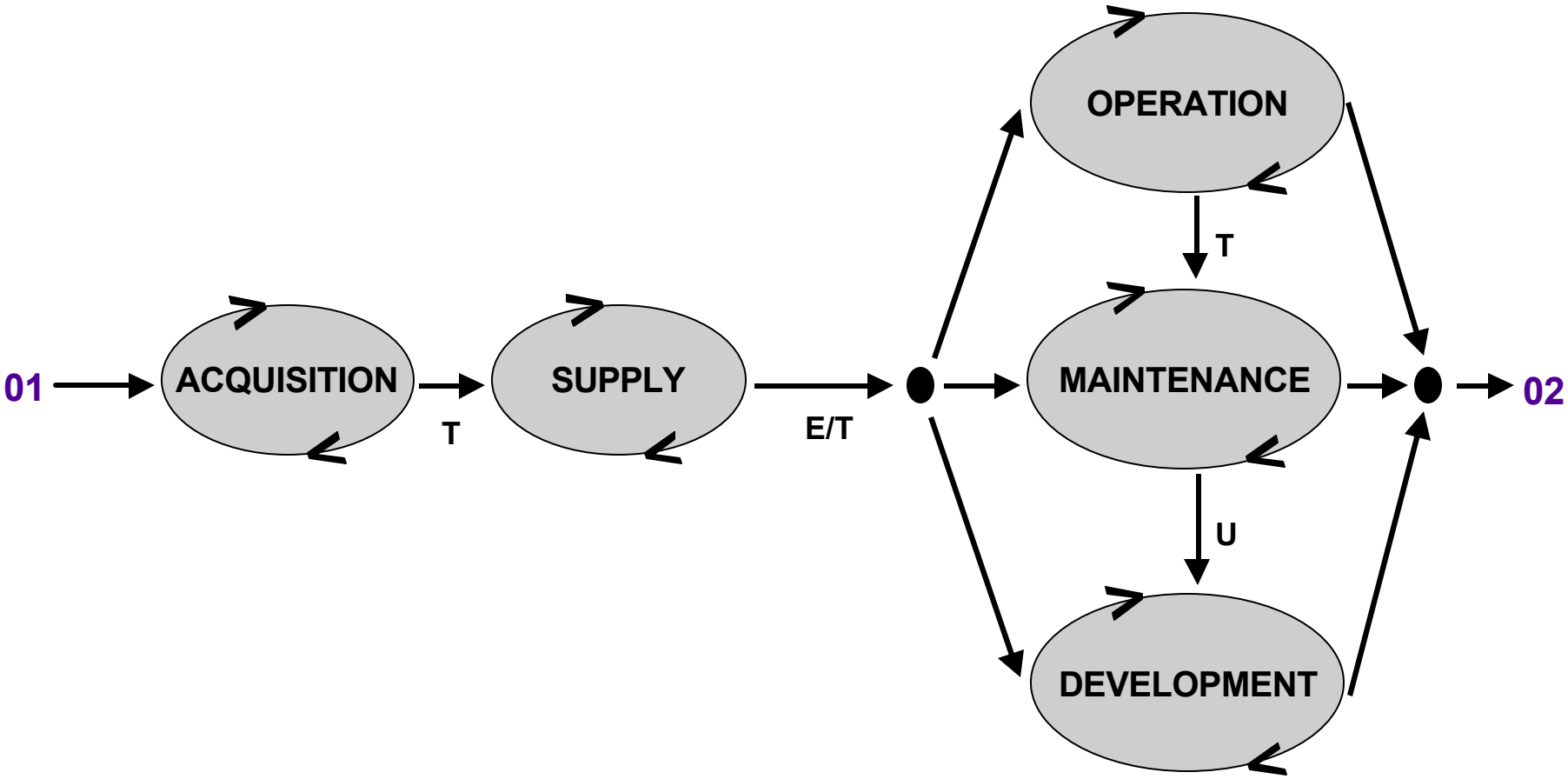
EVALUATION

It's an elementary function!





PRIMARY PROCESSES



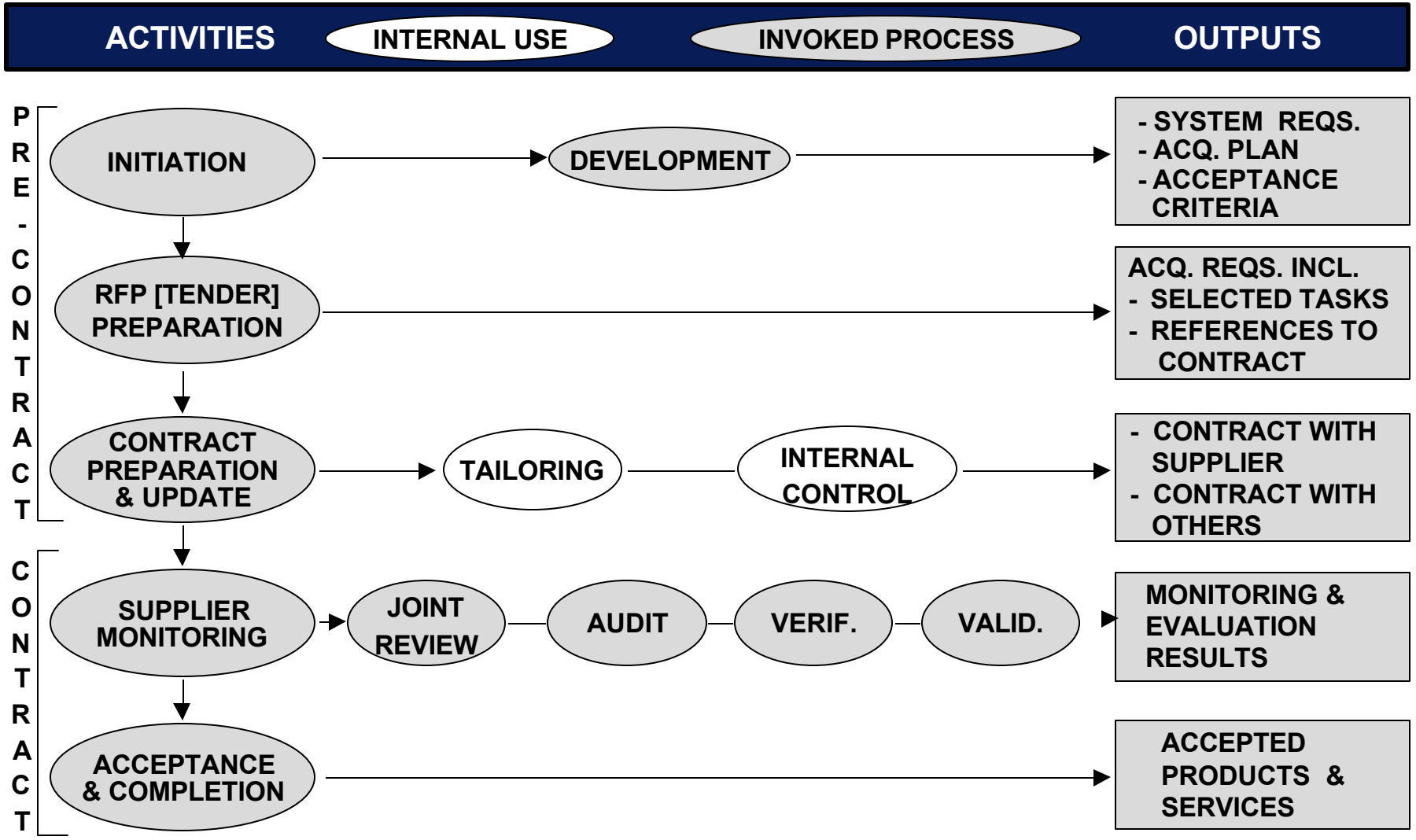
01: START HERE

O1, O2: THE SAME POINTS

E: EXECUTE; T: TASK; U: USE

ACQUISITION PROCESS

- FOR THE ACQUIRER OF SOFTWARE PRODUCTS AND SERVICES.
- COVERS PRE-CONTRACT AND CONTRACT PERIODS.



ACQUISITION PROCESS

ACTIVITIES & TASKS

1. INITIATION

- DESCRIBE THE NEEDS
- DEFINE SYSTEM REQUIREMENTS
- DEFINE SOFTWARE REQS. (MAYBE)
- PREPARE ACQUISITION PLAN
- DEFINE ACCEPTANCE STRATEGY

2. RFP [TENDER]

- DOCUMENT ACQUISITION REQS.
- SELECT ACTIVITIES & TASKS
- DEFINE REFS. TO CONTRACT
- SET REVIEW MILESTONES

3. CONTRACT PREPARATION & UPDATE

- ESTABLISH SUPPLIER SELECTION PROCEDURES
- SELECT SUPPLIER
- TAILOR 12207;
  - INVOLVE PARTIES
- NEGOTIATE CONTRACT

>> CONTRACT UNDERWAY

4. SUPPLIER MONITORING

- MONITOR IN ACCORDANCE WITH JOINT REVIEW & AUDIT
- SUPPLEMENT WITH V & V

5. ACCEPTANCE & COMPLETION

- PREPARE FOR ACCEPTANCE; INCLUDE TESTS
- CONDUCT ACCEPTANCE REVIEW & TESTING
- ACCEPT DELIVERABLES
- ASSUME CM

SUPPLY PROCESS

- FOR THE PROVIDER OF PRODUCTS/SERVICES.
- COVERS PRE-CONTRACT AND CONTRACT PERIODS.

ACTIVITIES | INTERNAL USE | INVOKED PROCESS | OUTPUTS

PRE-CONTRACT

INITIATION → BID DECISION

PREPARATION OF RESPONSE → PROPOSAL

CONTRACT

CONTRACT → CONTRACT

PLANNING → LC MODEL & PROJ. MGMT. PLAN

SELECT ONE OR MORE

EXECUTION & CONTROL → MONITOR, CONTROL → DEV. / OPN. / MNT. / ACQ. → MONITORING RESULTS

REVIEW & EVALUATION → JT. REV. / AUDIT / V&V / QA → REVIEW/ EVALUATION RESULTS

DELIVERY & COMPLETION → DELIVERED PRODUCTS/ SERVICES

SUPPLY PROCESS

ACTIVITIES & TASKS

1. INITIATION

- REVIEW RFP
- DECIDE TO BID; ACCEPT CONTRACT

2. PREPARATION OF RESPONSE

- PREPARE PROPOSAL

3. CONTRACT

- NEGOTIATE & ENTER INTO CONTRACT WITH ACQUIRER
- REQUEST MODS.

>> CONTRACT UNDERWAY

4. PLANNING

- REVIEW ACQ REQS
- SELECT LIFE CYCLE MODEL, AS NEEDED
- ESTABLISH REQS. FOR PLANS
- DEVELOP & DOCUMENT PROJECT MANAGEMENT PLANS [PMP; 15 ITEMS]

5. EXECUTION & CONTROL

- EXECUTE PMPs
- DEVELOP, OPERATE, OR MAINTAIN
- MONITOR/CONTROL PROGRESS/QUALITY
- MANAGE SUBS
- INTERFACE WITH IVVT
- INTERFACE WITH OTHER PARTIES

6. REVIEW & EVALUATION

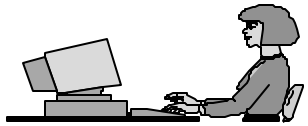
- COORDINATE WITH ACQUIRER
- JOINT REVIEW
- AUDIT
- V&V
- ACCESS TO ACQUIRER
- QA PER QA PROCESS

7. DELIVERY & COMPLETION

- DELIVER PRODUCT OR SERVICE
- PROVIDE ASSISTANCE

DEVELOPMENT PROCESS

- FOR THE DEVELOPER (MODIFIER) OF SOFTWARE PRODUCTS
- MAY PERFORM OR SUPPORT SOME SYSTEM ENGINEERING
- ACTIVITIES NOT NECESSARILY IN TIME ORDER



ACTIVITIES	INTERNAL USE		INVOKED PROCESS	OUTPUTS
PROCESS IMPLEMENTATION	DOCUMENTATION	C.M.	PROBLEM RESOLUTION	DEVELOPMENT PLANS & MODELS
SYS. REQ. ANALYSIS	EVALUATIONS			SYSTEM REQUIREMENTS
SYS. ARCH. DESIGN	EVALUATIONS			SYS. ARCHITECTURE - HW, SW, MO
SW REQ. ANALYSIS	EVALUATIONS	ISO/IEC 9126	JT. REVIEWS	SOFTWARE REQUIREMENTS
SW ARCH. DESIGN	EVALUATIONS		JT. REVIEWS	SOFTWARE ARCHITECTURE
SW DET. DESIGN	EVALUATIONS		JT. REVIEWS	SOFTWARE DETAILED DESIGN
SW CODE/TEST	EVALUATIONS			SOFTWARE CODE/DATABASE
SW INTEGRATION	EVALUATIONS		JT. REVIEWS	INTEGRATED SOFTWARE (SCIs)
SW QUALIF. TEST	EVALUATIONS		AUDITS	QUALIFIED SCIs (DESIGN & CODE)
SYS. INTEGRATION	EVALUATIONS			INTEGRATED SYSTEM
SYS. QUALIF. TEST	EVALUATIONS		AUDITS	QUALIFIED SYSTEM
SW INSTALLATION	EVALUATIONS			INSTALLATION PLAN INSTALLED SW
SW ACCPT. SUPPORT				DELIVERABLE SOFTWARE

DEVELOPMENT PROCESS
ACTIVITIES & TASKS

1. PROCESS IMPLEMENTATION

- DEFINE/SELECT DEVELOPMENT MODEL(s)
  - The foundation of a project
  - Detailed with iterations/recursions of the activities & tasks of Development and invoked Supporting processes
- EMPLOY REGULARLY DOC, CM, AND PROB. RES. PROCESSES
- SELECT/TAILOR INTERNAL METHODS/TOOLS/...
- DEVELOP, DOCUMENT, EXECUTE PLANS
- MAY USE NON-DELIVERABLES
  - Avoid dependency of future operations & maintenance on these

2,3,10,11. SYSTEM ACTIVITIES

- PERFORM OR SUPPORT

4-9, 12,13. SOFTWARE ACTIVITIES

- PERFORM

3. SYSTEM ARCHITECTURAL DESIGN

- PRODUCE AN ARCHITECTURE OF THE SYSTEM
- IDENTIFY HW, SW AND MANUAL OPERATIONS ITEMS

5. SOFTWARE ARCHITECTURAL DESIGN

- PRODUCE AN ARCHITECTURE OF THE SOFTWARE ITEM
- IDENTIFY COMPONENTS OF THE SOFTWARE ITEM

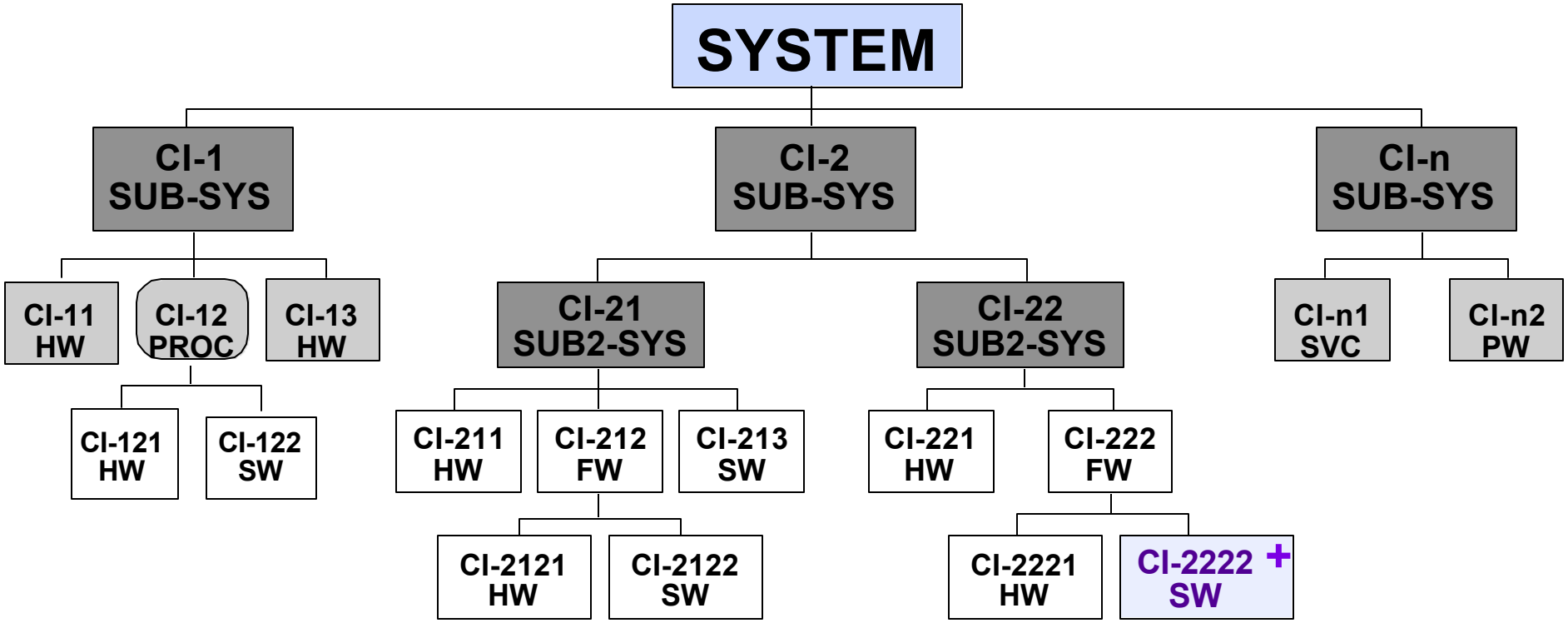
7. SOFTWARE CODING & TESTING

- CODE UNITS & DATABASES
- IF NEEDED, CODE SHOULD BE COMPILABLE AND TESTABLE

8. SOFTWARE INTEGRATION
10. SYSTEM INTEGRATION

- INTEGRATE IN AGGREGATES
- PARTITION AND INTEGRATION PATHS MAY BE DIFFERENT

ORGANIZATION OF A SYSTEM
AN EXAMPLE

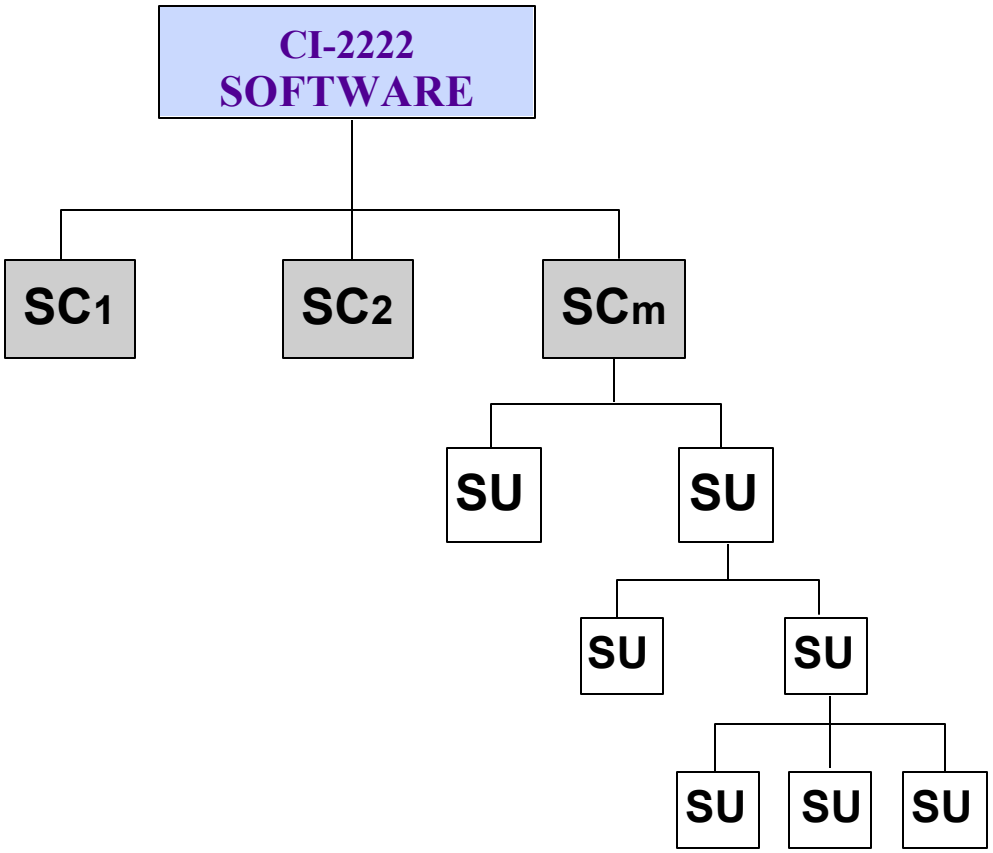


LEGEND: CI: CONFIGURATION ITEM;
HW: HARDWARE; SW: SOFTWARE; FW: FIRMWARE, PW: PEOPLEWARE
PROC: PROCESS; SVC: SERVICE.

- LOWER CIs MAY BE PARTITIONED FURTHER UNTIL SUITABLE FOR INDIVIDUAL TREATMENT
- THE CIs MAY BE NOT ALL DISTINCT
- PARTITIONING AND INTEGRATION PATHS CAN BE DIFFERENT

+ CONTINUED TO THE NEXT CHART

+ SOFTWARE ORGANIZATION
[CI-2222 FROM THE PREVIOUS CHART]

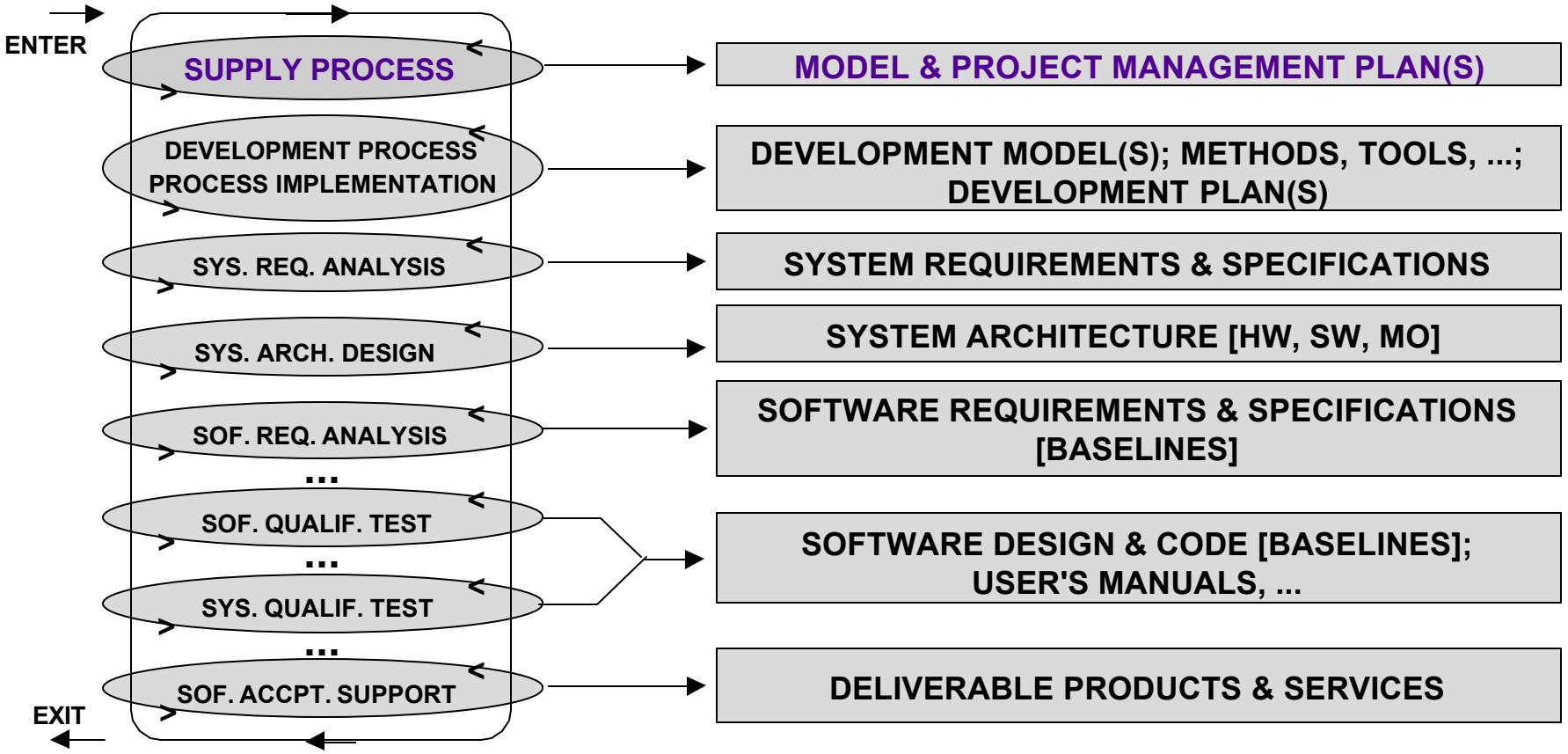


LEGEND:
SC - SOFTWARE COMPONENT; SU -SOFTWARE UNIT

- **12207 ASKS FOR ARCHITECTURE AND DESIGN, BUT DOES NOT IMPLY STYLE, REPRESENTATION OR DERIVATION METHODS**
- **SUs MAY BE NOT ALL DISTINCT**
- **IF NEEDED, AN SU MUST BE COMPILABLE AND TESTABLE**
- **DECOMPOSITION AND INTEGRATION PATHS MAY BE DIFFERENT**

DEVELOPMENT PROCESS

THE HORSE

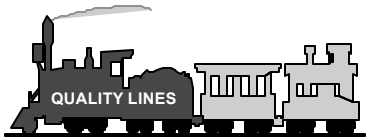


- ITERATIONS/RECURSIONS ENCOURAGED:
  - TO BUILD SPECIFIC MODELS
  - TO OFFSET DEFAULT MODELS
- ALL ACTIVITIES [TASKS] IN A PROCESS [ACTIVITY] NOT NEEDED IN EACH ITERATION OR RECURSION, BUT SHOULD BE COMPLETED BY THE FINAL ITERATION OR RECURSION

- PROJECTS ESTABLISH BASELINES
  - OF WHAT & WHEN
- BASELINING AT PRE-DETERMINED REVIEWS/AUDITS
  - FORUM TO INVOLVE KEY PARTIES
- BASELINES INHIBIT UNPLANNED OR EASY CHANGES
- AT LEAST 3 BASELINED PRODUCTS:
  - REQUIREMENTS, DESIGN, CODE

OPERATION PROCESS

- FOR THE OPERATOR OF A SYSTEM CONTAINING SOFTWARE



ACTIVITIES	INTERNAL USE	INVOKED PROCESS	OUTPUTS
PROCESS IMPLEMENTATION	PROBLEM RESOLUTION	MAINTENANCE	- OPERATION PLAN - OPERATION PROCEDURES
OPERATIONAL TESTING	INTERNAL TESTING & ENSURANCE		RELEASED OPERATIONAL SOFTWARE
SYSTEM OPERATION			[FUNCTIONS PERFORMED]
USER SUPPORT			- USER REQUESTS - PROBLEM RESOLUTIONS

OPERATION PROCESS
ACTIVITIES & TASKS

1. PROCESS IMPLEMENTATION

- DEVELOP OPERATIONAL PLAN
- SET OPERATIONAL STANDARDS
- DOCUMENT AND EXECUTE PLAN
- ESTABLISH PROCEDURES FOR/WITH PROBLEM RESOLUTIONS
- ESTABLISH PROCEDURES FOR OPERATIONAL TESTING
- ESTABLISH PROCEDURES FOR INTERFACING WITH MAINTENANCE PROCESS
- ESTABLISH PROCEDURES FOR RELEASING PRODUCTS FOR OPERATIONAL USE

2. OPERATIONAL TESTING

- PERFORM OPERATIONAL TESTING FOR EACH RELEASE
- RELEASE AFTER CRITERIA MET
- ENSURE CODE/DATABASE PERFORM AS PLANNED

3. SYSTEM OPERATION

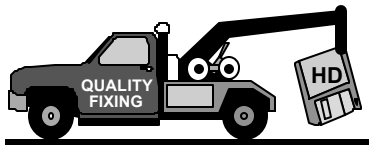
- OPERATE IN ENVIRONMENT

4. USER SUPPORT

- PROVIDE ASSISTANCE TO USERS
- FORWARD USER REQUESTS TO MAINTENANCE AS NEEDED
- FOR TEMPORARY FIXES, PROVIDE OPTION TO USE IT

MAINTENANCE PROCESS

• FOR THE MAINTAINER OF SOFTWARE PRODUCTS



ACTIVITIES	INTERNAL USE	INVOKED PROCESS	OUTPUTS
PROCESS IMPLEMENT	PROBLEM RESOLUTION	CM	MAINTENANCE PLANS/PROCS.
PROB/MOD. ANALYSIS			PROB./MOD. ANAL/SOLN.
MOD. IMPLEMENT.		DEVELOPMENT	MODIFIED SOFTWARE
MAINT. REVIEW/ ACCEPT.	INTERNAL REVIEWS		REVIEW RESULTS
MIGRATION	INTERNAL REVIEWS		- MIGRATION PLANS/REPORTS - MIGRATED SYS.
SOFTWARE RETIREMENT			- RETIREMENT PLANS - ARCHIVES

MAINTENANCE PROCESS
ACTIVITIES & TASKS

1. PROCESS IMPLEMENTATION

- Develop, document and execute plan
- Establish procedures for problem reports and modifications requests
- Manage modifications

3. MODIFICATION IMPLEMENTATION

- Determine targets of modifications
- Use Development Process for mods.
- Supplement with testing to ensure modified and unmodified parts are correctly done

5. MIGRATION

- Develop/document/ execute plan
- Notify users, etc.
- Do parallel operations
- Do post-operations for impact

2. PROBLEM/ MODIFICATION ANALYSIS

- Analyze modifications for impacts
- Replicate/verify problems
- Implement modifications
- Document and get approval

4. MAINTENANCE REVIEW/ ACCEPTANCE

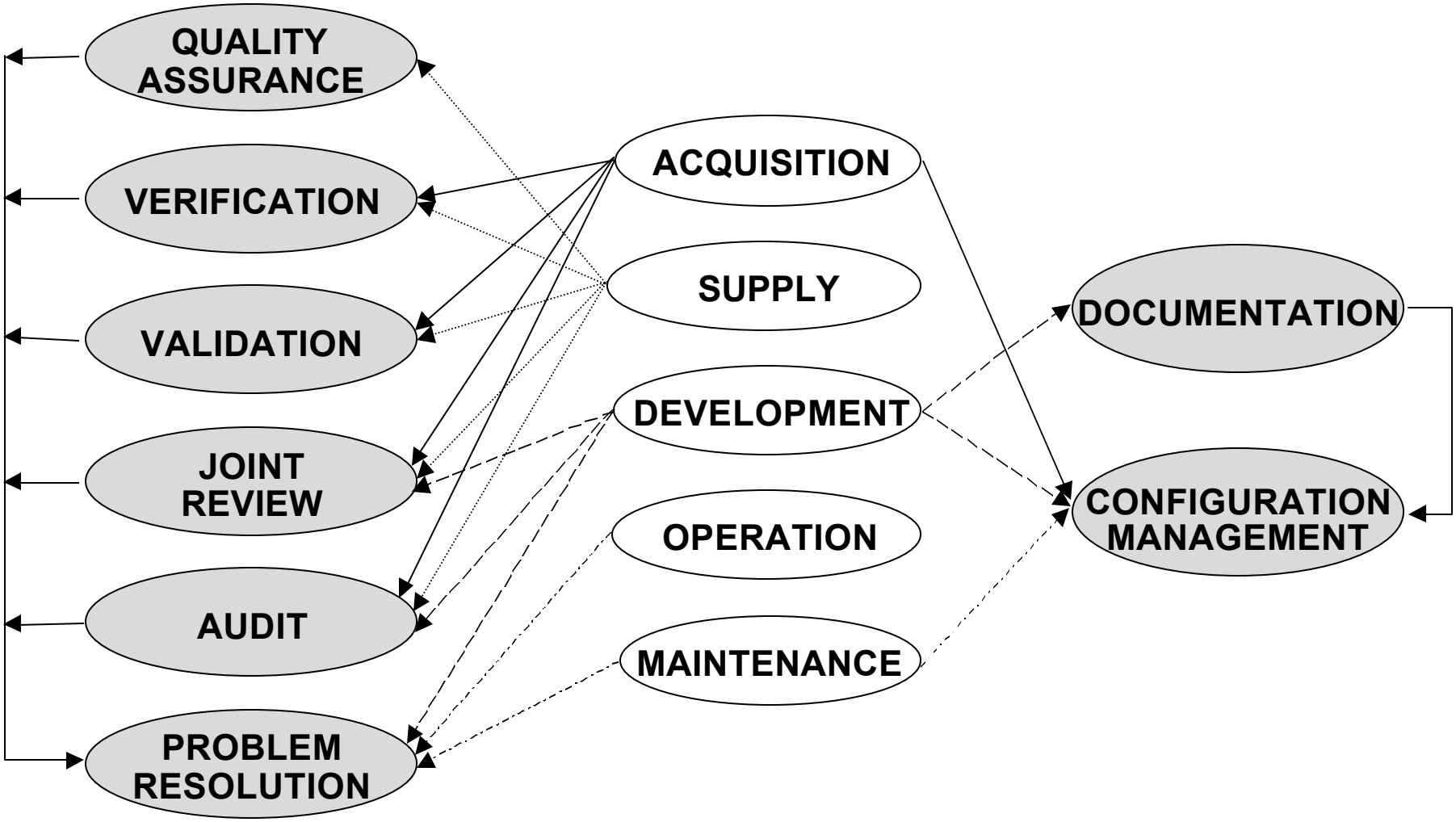
- Review with authorizing organization

6. SOFTWARE RETIREMENT

- Develop/document/ execute plan
- Notify users, etc.
- Do parallel operations
- Provide for access to retired data/products

SUPPORTING PROCESSES

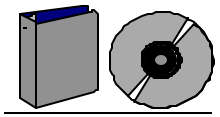
- TO SUPPORT ANOTHER PROCESS BY PERFORMING A SPECIFIC FUNCTION

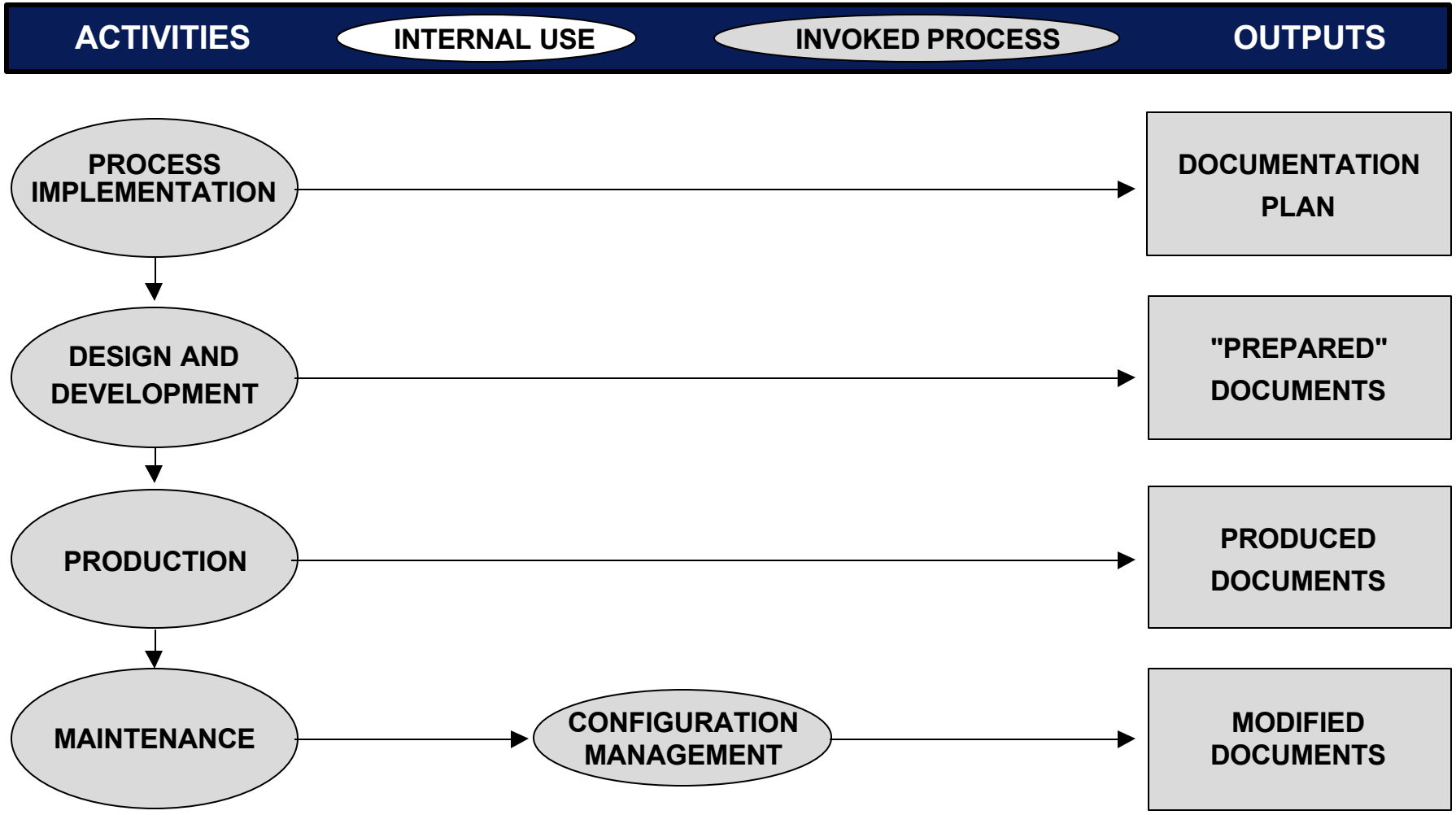


ARROWS: EMPLOY/INVOKE

DOCUMENTATION PROCESS

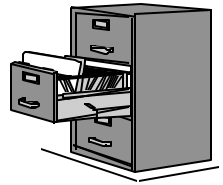
- FOR ESTABLISHING DOCUMENTATION STANDARDS:
  MEDIA, FORMAT, OUTLINE, CONTENT, FILING, DISTRIBUTION, ...
  - EXAMPLES: YOUR ORGANIZATION'S USER'S MANUALS;
    US DOD DIDs; IEEE SRS, ...
- THIS PROCESS DOES NOT PRESCRIBE ANY OF ABOVE;
  THE INVOKING PROCESS DOES

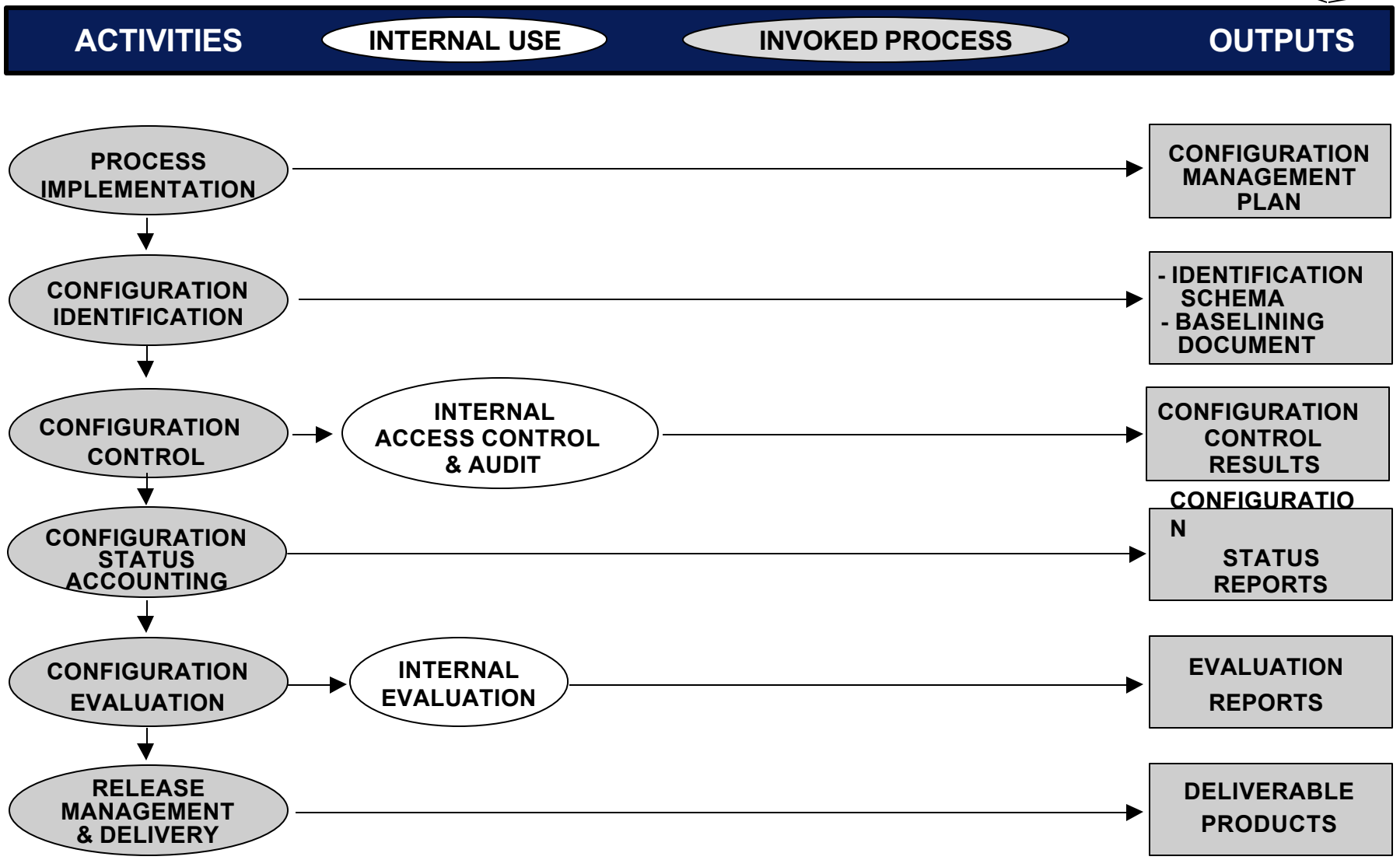




CONFIGURATION MANAGEMENT PROCESS

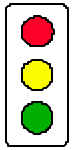
- FOR CM OF PRODUCTS AND TASKS
- INTERNAL OR EXTERNAL TO THE INVOKING PROCESS
- THIS PROCESS IDENTIFIES BASELINED PRODUCTS; THE INVOKING PROCESS ESTABLISHES BASELINES

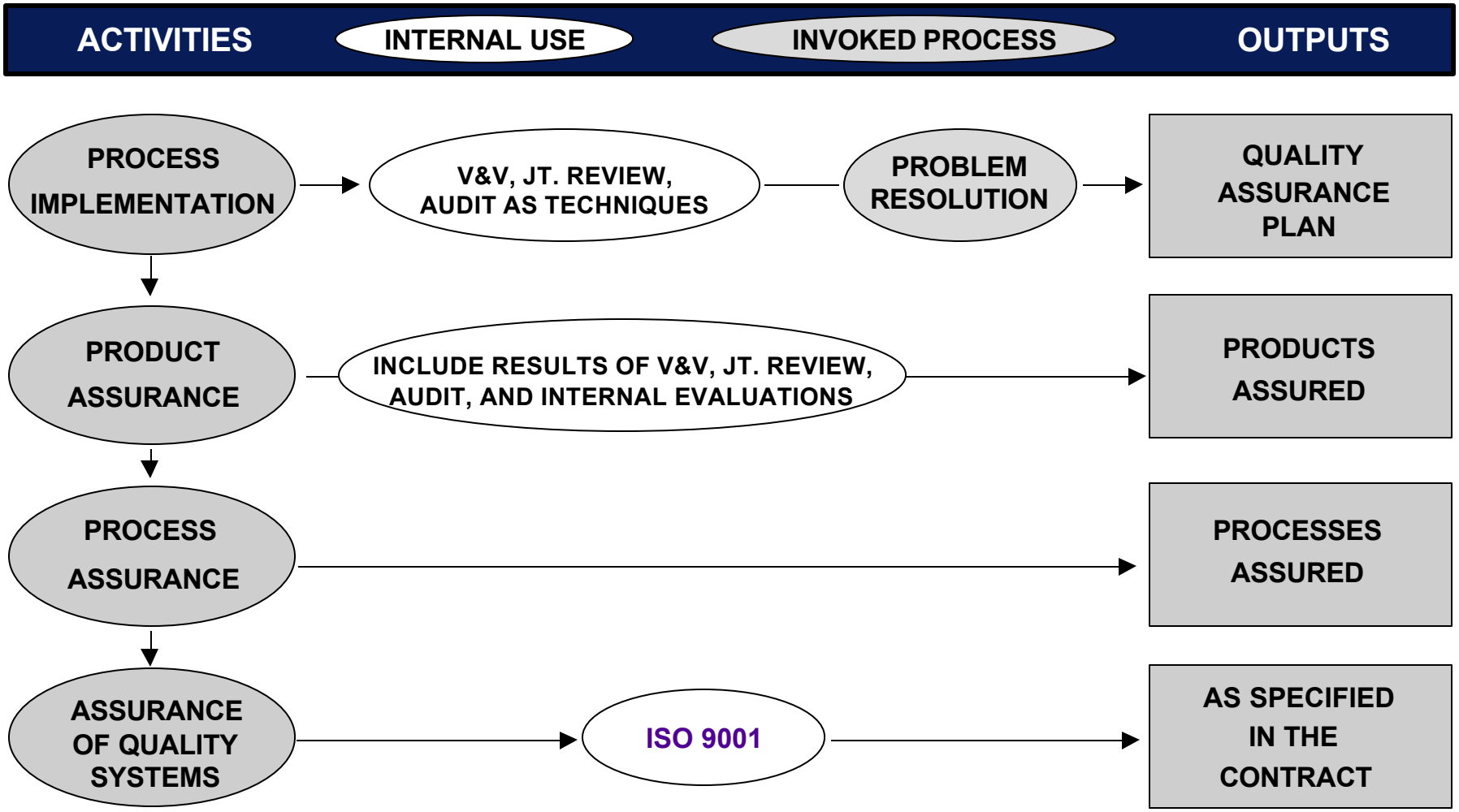




QUALITY ASSURANCE PROCESS

- FOR ASSURING CONFORMANCE OF PRODUCTS/SERVICES WITH REQUIREMENTS AND ADHERENCE TO PLANS
- EXTERNAL, WITH ORGANIZATIONAL FREEDOM
- USES THE TERM "ASSURE" INSTEAD OF "EVALUATE"





QUALITY ASSURANCE PROCESS
ACTIVITIES AND TASKS

1. PROCESS IMPLEMENTATION

- ESTABLISH QA PROCESS FOR THE PROJECT
- DEVELOP/DOCUMENT/ EXECUTE QA PLAN
- COORDINATE WITH VERIFICATION, VALIDATION, JOINT REVIEW, AUDIT PROCESSES

2. PRODUCT ASSURANCE

ASSURE THAT:

- PLANS ARE DOCUMENTED/ COMPLIANT/EXECUTED
- PRODUCTS/DOCUMENTATION ARE COMPLIANT & ADHERENT
- PRODUCTS ARE DELIVERABLE/ ACCEPTABLE TO ACQUIRER

3. PROCESS ASSURANCE

ASSURE THAT:

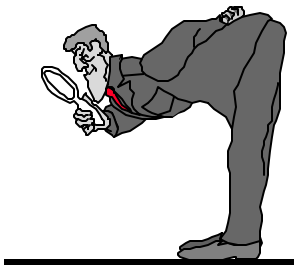
- EMPLOYED PROCESSES ARE COMPLIANT & ADHERENT
- INTERNAL ENGINEERING PRACTICES ARE COMPLIANT
- PRIME REQUIREMENTS ARE PASSED DOWN TO SUBCONTRACTORS
- OTHER PARTIES ARE PROVIDED SUPPORT
- TRAINED STAFF AND TRAINING ARE IN PLACE

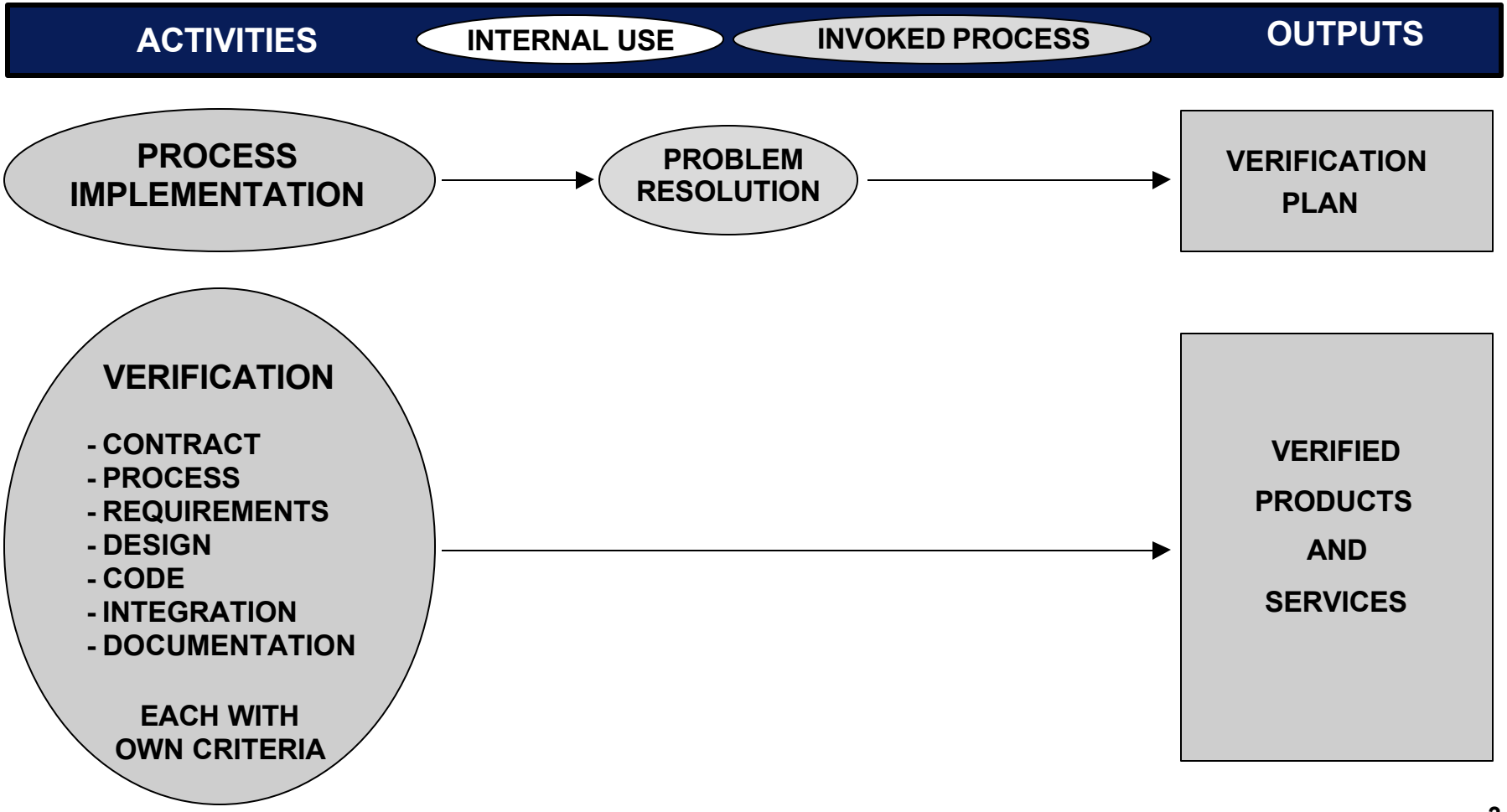
4. ASSURANCE OF QUALITY SYSTEM

- ADDITIONAL QUALITY MANAGEMENT PER ISO 9001

VERIFICATION PROCESS

- FOR VERIFICATION OF REQUIREMENTS IN AN ACTIVITY AGAINST THOSE IN PREVIOUS ACTIVITY
- INTERNAL OR INDEPENDENT
- USES THE TERM "VERIFY" INSTEAD OF "EVALUATE"
- PRIMARILY FOR DEVELOPMENT PROCESS;
  - OPERATION AND MAINTENANCE NOT COVERED.





VERIFICATION PROCESS
ACTIVITIES AND TASKS

1. PROCESS IMPLEMENTATION
- DETERMINE IF AND HOW MUCH NEEDED
  - USE CRITICALITY FACTORS
- DETERMINE DEGREE OF INDEPENDENCE

2. CONTRACT VERIFICATION
- SUPPLIER IS CAPABLE
- USER NEEDS ARE COVERED
- HANDLING REQS CHANGES ADEQUATE
- PARTIES' INTERFACES STIPULATED

3. PROCESS VERIFICATION
- PLANNING ADEQUATE/TIMELY
- PROCESSES ADEQUATE/IMPLEMENTED BEING EXECUTED/COMPLIANT
- STANDARDS/PROCEDURES/ ENVIRONMENTS ADEQUATE
- PERSONNEL STAFFED AND TRAINED

4. REQS. VERIFICATION
- CONSISTENT/FEASIBLE/TESTABLE
- ALLOCATIONS APPROPRIATE
- CRITICALITY REQS. CORRECT BY RIGOROUS METHODS

5. DESIGN VERIFICATION
- CORRECT/CONSISTENT\TRACEABLE
- PROPER SEQUENCE/ALLOCATION OF EVENTS, I/O, INTERFACES, LOGIC, TIMING, SIZING, RECOVERY, ...
- DESIGN IMPLEMENTS CRITICALITY REQS. CORRECTLY [SHOW BY RIGOROUS METHODS]

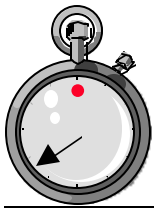
6. CODE VERIFICATION
- CORRECT/TESTABLE\TRACEABLE
- SIMILAR TO ABOVE

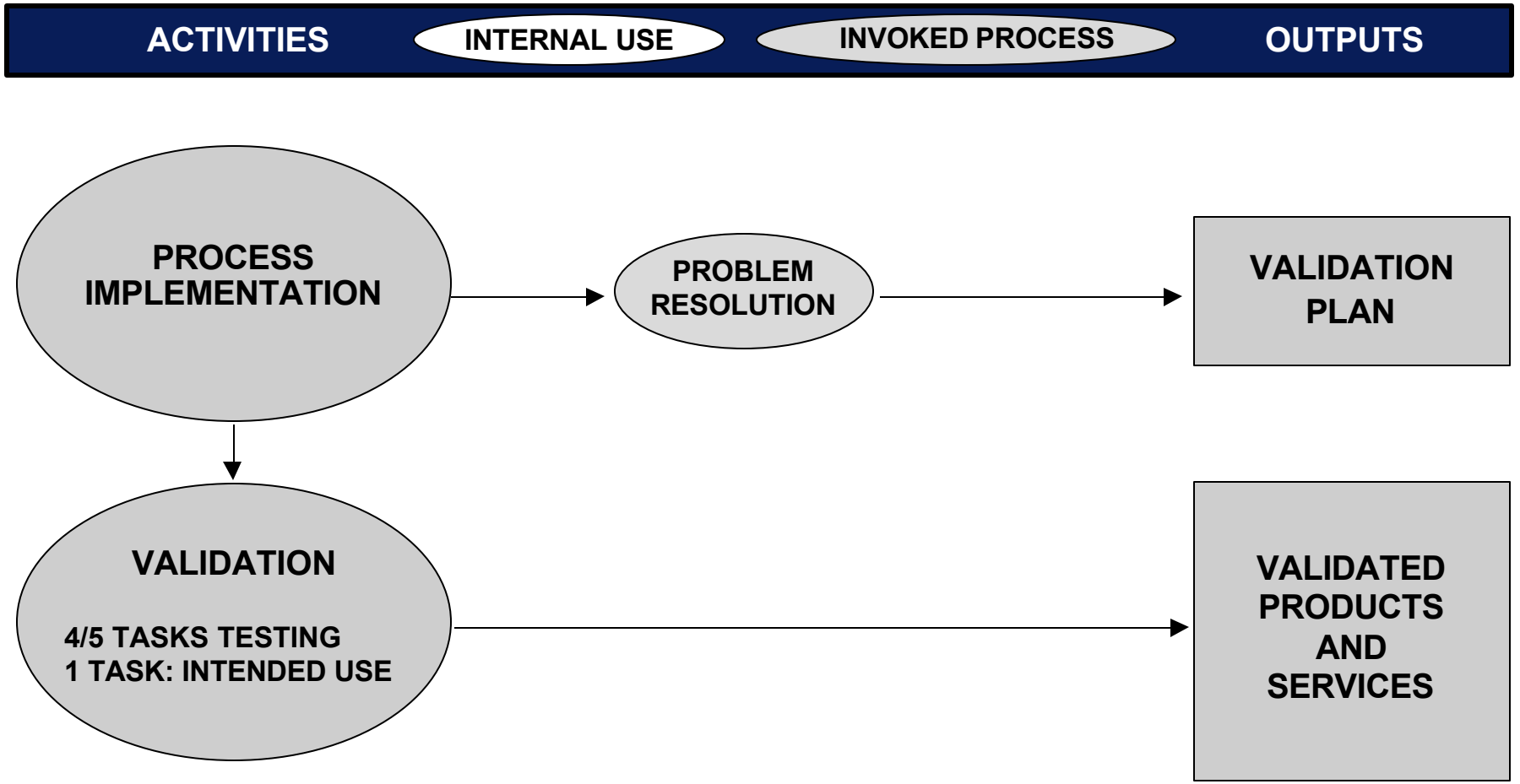
7. INTEGRATION VERIFICATION
- COMPONENTS/UNITS INTEGRATED COMPLETELY/CORRECTLY
- ITEMS INTEGRATED INTO SYSTEM COMPLETELY AND CORRECTLY
- PERFORMED PER PLANS

8. DOC. VERIFICATION
- ADEQUATE/COMPLETE/CONSISTENT
- TIMELY
- FOLLOWS CM

VALIDATION PROCESS

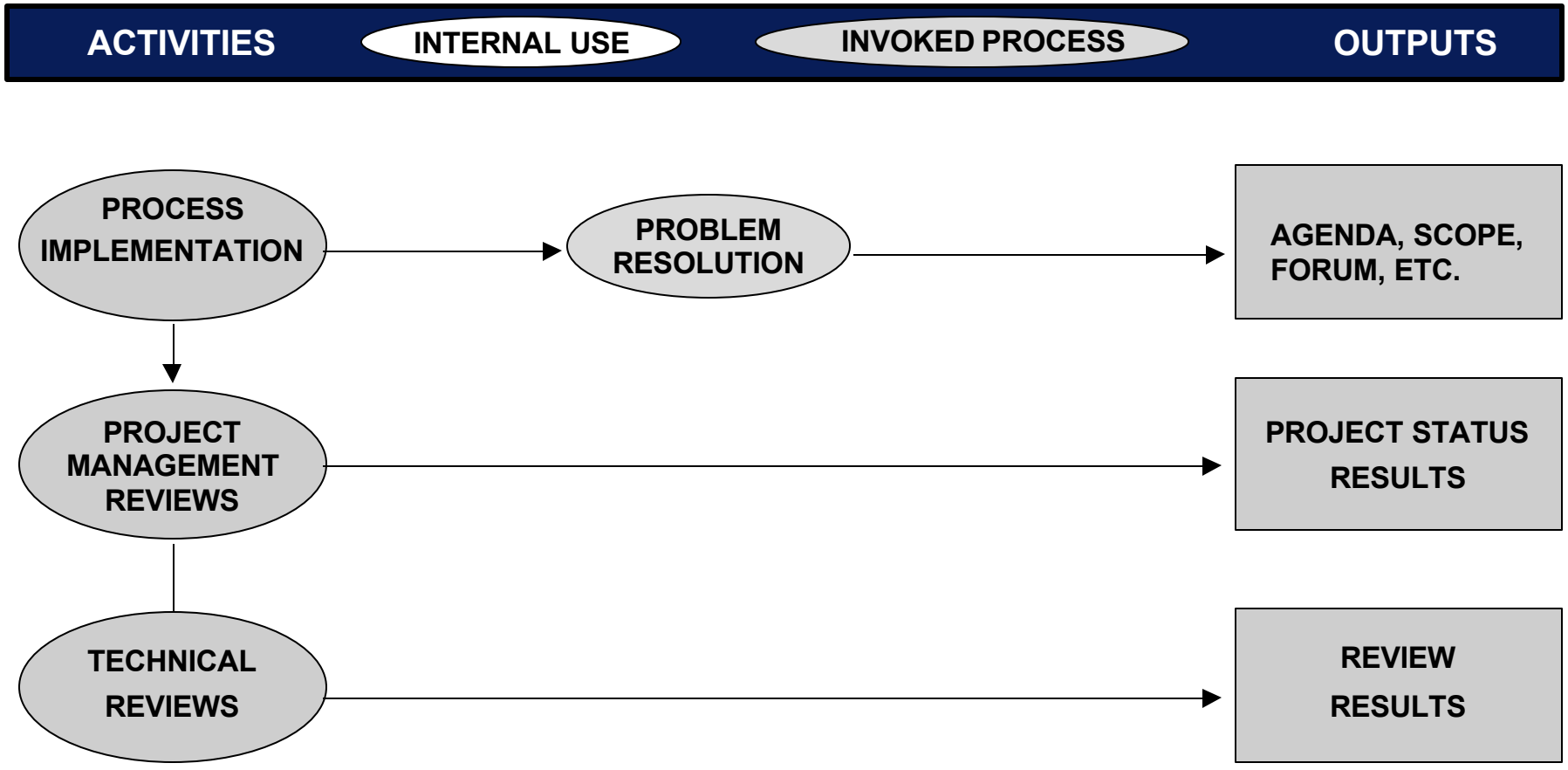
- FOR VALIDATION OF AS-BUILT PRODUCTS AGAINST SPECIFIED CRITERIA
- INTERNAL OR INDEPENDENT
- USES THE TERM "VALIDATE" INSTEAD OF "EVALUATE"
- CONFIDENCE IN VALIDATION: THROUGH TESTING





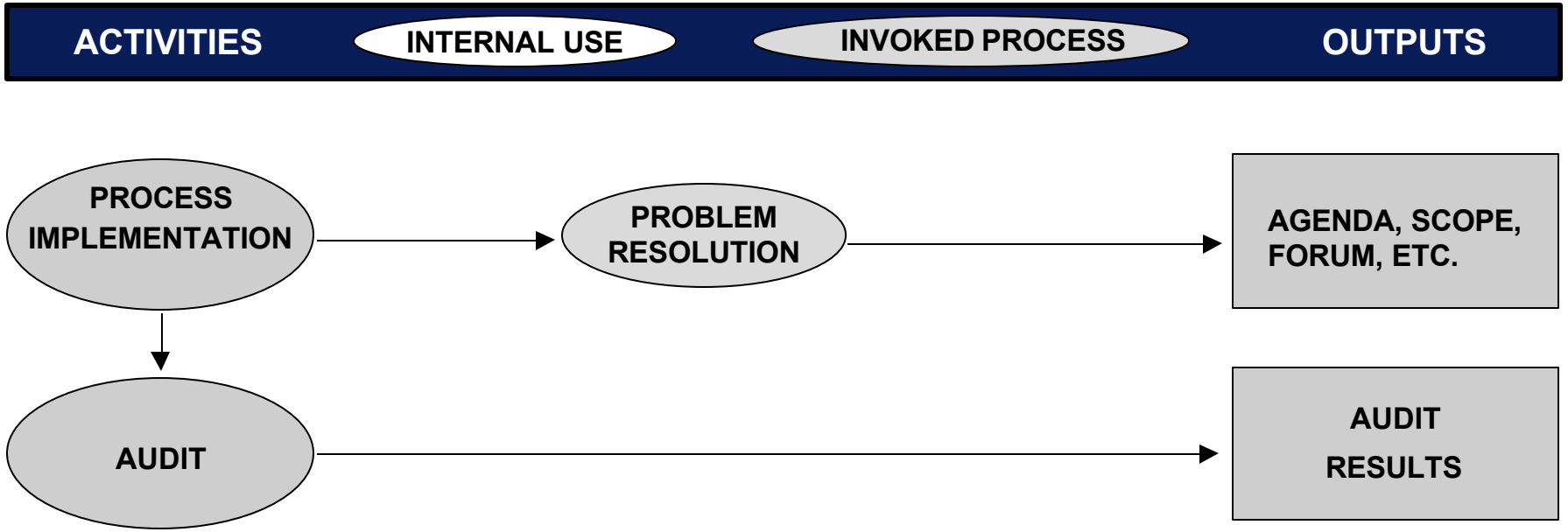
JOINT REVIEW PROCESS

- FOR JOINT REVIEWS BETWEEN REVIEWER AND REVIEWEE
  - TYPICALLY BY SUPPLIER WITH ACQUIRER
  - BOTH TECHNICAL AND MANAGEMENT
- REVIEW OF PROJECT STATUS, PRODUCTS AND TASKS FOR COMPLETENESS, COMPLIANCE AND ADHERENCE



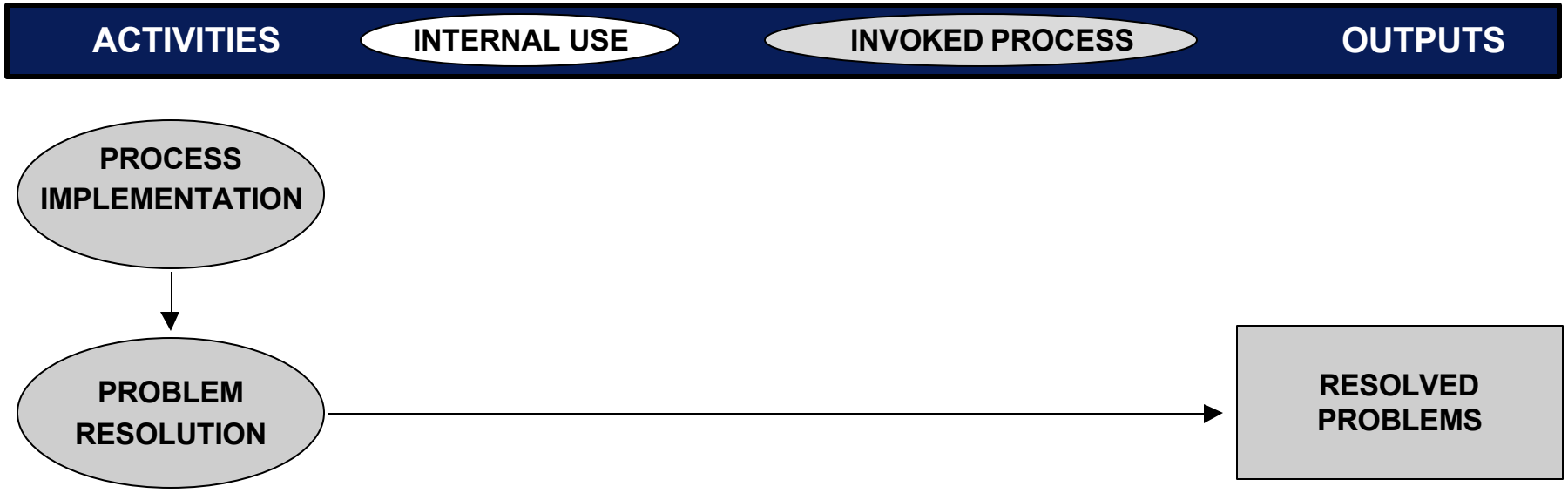
AUDIT PROCESS

- FOR AUDITS BETWEEN AUDITOR AND AUDITEE
  - TYPICALLY BY ACQUIRER WITH SUPPLIER
- FOR COMPLIANCE WITH REQUIREMENTS/PLANS/CONTRACT



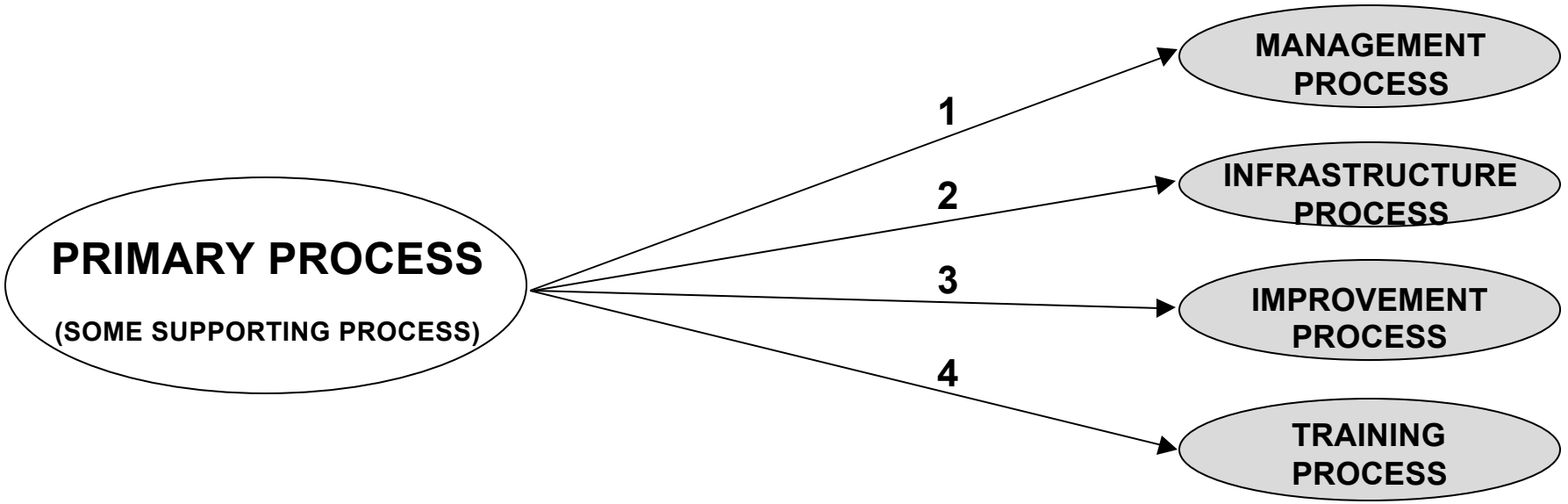
PROBLEM RESOLUTION PROCESS

- FOR ANALYZING AND RESOLVING PROBLEMS, TAKING CORRECTIVE ACTIONS, AND DETECTING TRENDS
  - THE "A" OF THE PDCA CYCLE.
- A CLOSED LOOP PROCESS:
  - PROBLEMS REPORTED/ENTERED
  - ACTION TAKEN
  - CAUSES IDENTIFIED/ELIMINATED
  - RESOLUTION/DISPOSITION ACHIEVED/RECORDED
  - TREND DETECTED
- NOTE: NOT EVERY PROBLEM NEEDS CORRECTIVE ACTION



ORGANIZATIONAL PROCESSES

- FOR AN ORGANIZATION TO MANAGE AND IMPROVE ITS PROCESSES AT CORPORATE LEVEL
- THE ORGANIZATION IS RESPONSIBLE FOR ESTABLISHING AND INSTITUTIONALIZING THE LIFE CYCLE PROCESSES



1: MANAGE FOLLOWING MANAGEMENT PROCESS
2: ESTABLISH INFRASTRUCTURE FOLLOWING INFRASTRUCTURE PROCESS
3: IMPROVE FOLLOWING IMPROVEMENT PROCESS
4: TRAIN PERSONNEL FOLLOWING TRAINING PROCESS

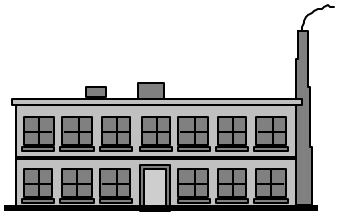
MANAGEMENT PROCESS

- FOR GENERAL MANAGEMENT OF PROCESSES
- IT IS THE PDCA CYCLE
- IT IS INSTANTIATED IN OTHER PROCESSES

ACTIVITIES	INTERNAL USE	INVOKED PROCESS	OUTPUTS
INITIATION & SCOPE DEFINITION			[PROCESS REQUIREMENTS]
PLANNING			MANAGEMENT PLAN
EXECUTION & CONTROL			[REPORTS]
REVIEW & EVALUATION			[REPORTS]
CLOSURE			[PRODUCTS] [SERVICES]

INFRASTRUCTURE PROCESS

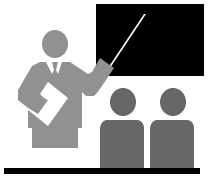
- FOR ESTABLISHING AND MAINTAINING INFRASTRUCTURE OF A LIFE CYCLE PROCESS
- INFRASTRUCTURE: PROCEDURES, STANDARDS, TOOLS, EQUIPMENT, SPACE



ACTIVITIES	INTERNAL USE	INVOKED PROCESS	OUTPUTS

TRAINING PROCESS

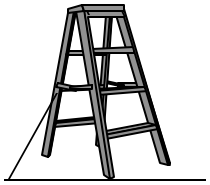
- FOR PROVIDING AND MAINTAINING TRAINED PERSONNEL



ACTIVITIES	INTERNAL USE	INVOKED PROCESS	OUTPUTS

IMPROVEMENT PROCESS

- **FOR ESTABLISHING, ASSESSING, MEASURING, CONTROLLING, AND IMPROVING A LIFE CYCLE PROCESS**



ACTIVITIES	INTERNAL USE	INVOKED PROCESS	OUTPUTS
PROCESS ESTABLISHMENT			[ESTABLISHED PROCESS(ES)]
PROCESS ASSESSMENT			ASSESSMENT PROCEDURES AND PLANS
PROCESS IMPROVEMENT			[EVALUATION, HISTORICAL, QUALITY COST RECORDS]

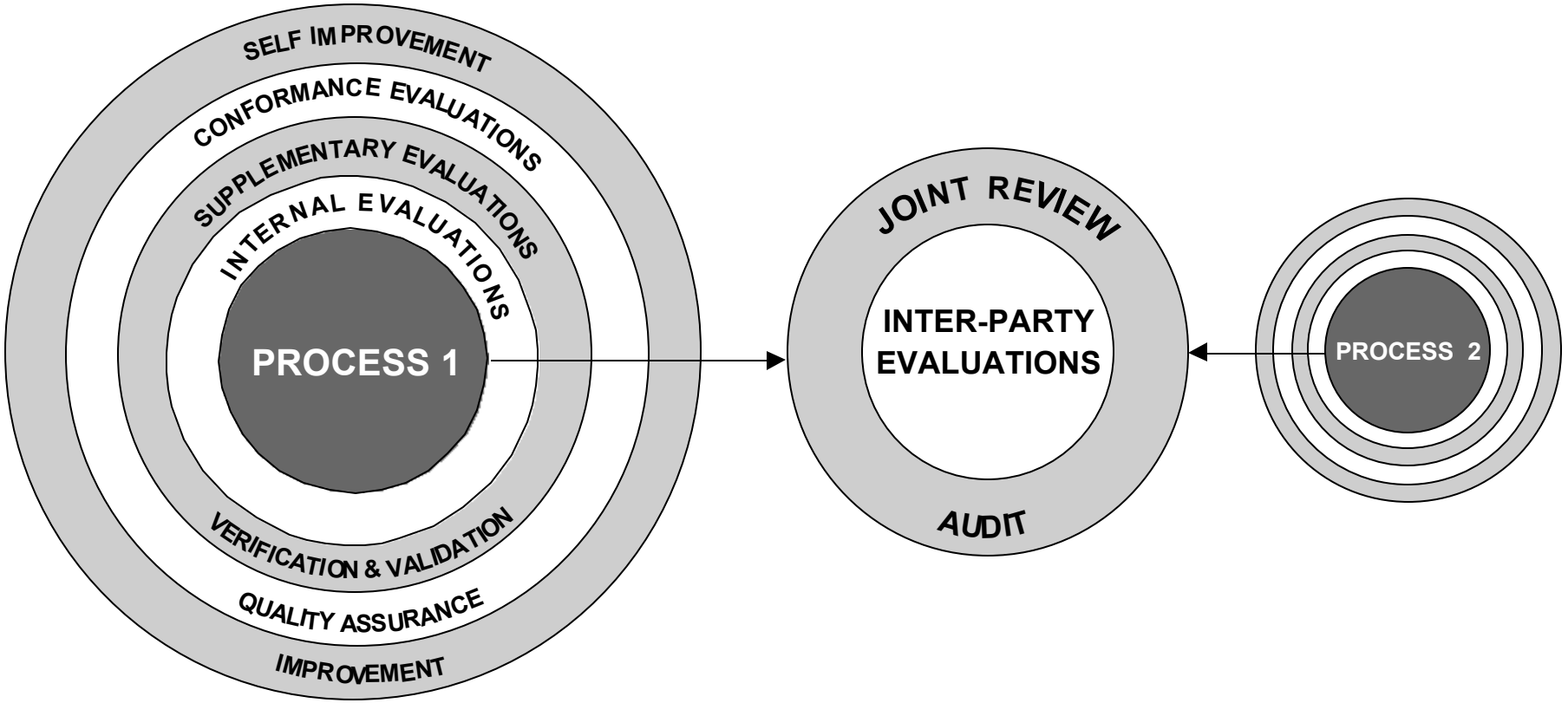
TAILORING PROCESS
A SPECIAL PROCESS

- FOR BASIC TAILORING OF THE STANDARD FOR PROJECTS
  - ADDITIONS IN AGREEMENT
  - ONLY 5 "SHALLS"
- TAILORING OF THIS PROCESS NOT ALLOWED

ACTIVITIES	INTERNAL USE	INVOKED PROCESS	OUTPUTS
IDENTIFYING PROJECT ENVIRONMENT			PROJECT'S CHARACTERISTICS
SOLICITING INPUTS			INPUTS FROM ORGANIZATIONS
SELECTING PROCESSES, ACTIVITIES, & TASKS			SELECTED PROCESSES, ACTIVITIES, & TASKS
DOCUMENTING TAILORING DECISIONS & RATIONALE			TAILORING DECISIONS & RATIONALE

EVALUATION-BASED PROCESSES

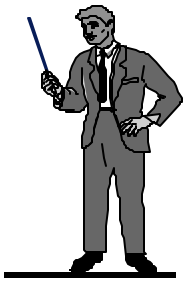
THE "C" OF THE PDCA CYCLE



- EVALUATION: BASIC TO ALL EVALUATION-BASED TASKS
- PROCESS-INTERNAL EVALUATIONS: AGAINST SPECIFIED CRITERIA
- VERIFICATION: AGAINST PREVIOUS ACTIVITIES
- VALIDATION: AGAINST INTENDED USE
- QA: ASSURANCE WITH RESPECT TO REQUIREMENTS/PLANS
- JOINT REVIEW: EVALUATIONS OF STATUS & PRODUCTS
- AUDIT: EVALUATIONS FOR COMPLIANCE WITH REQUIREMENTS/PLANS/CONTRACT

REQUIREMENTS

- **AN EXPECTATION/DEMAND AS A COMPLIANCE/OBLIGATION/AGREEMENT**
- **A QUALIFIER IDENTIFIES THE SOURCE & RECEIVER; OTHERWISE IN LOCAL CONTEXT**



PROCESS	TERM "REQUIREMENTS" and QUALIFIER USED
ACQUISITION	• ACQUISITION REQS; SYSTEM REQS; SOFTWARE REQS
SUPPLY	• ACQUISITION REQS • PLANNING REQS; CONTRACTUAL REQS; PRIME-CONTRACT REQS
DEVELOPMENT	• SYSTEM REQS & SPECS - ORGANIZATIONAL, USER, SAFETY, INTERFACE, QUALIFICATION, ... • SYSTEM REQS ALLOCATED TO ITEMS: HARDWARE, SOFTWARE, MANUAL OPERATIONS • SOFTWARE REQS FOR: ITEMS; COMPONENTS; UNITS • TEST REQS
MAINTENANCE	• NEW AND MODIFIED REQS
OTHER	• FOR LOCAL ACTION ON INCOMING REQS

CRITICAL FUNCTIONS

PROCESS	CRITICAL-FUNCTION RELATED TASKS
ACQUISITION	• DEFINE SAFETY/SECURITY/CRITICALITY REQUIREMENTS. • INCLUDE RELATED DESIGN/TESTING/COMPLIANCE STANDARDS/PROCEDURES.
SUPPLY	• ADDRESS IN PROJECT PLANS, MANAGEMENT OF: - SAFETY/SECURITY/CRITICALITY REQUIREMENTS - RELATED POLICY/REGULATION/CERTIFICATION • SEPARATE PLANS ENCOURAGED.
DEVELOPMENT	• ADDRESS PLANNING, ANALYSIS, DESIGN, AND QUALIFICATION OF SAFETY, SECURITY, AND CRITICALITY REQUIREMENTS, INCLUDING ERGONOMIC.
MAINTENANCE	• ANALYZE IMPACT OF MODIFICATIONS ON: SAFETY/SECURITY/CRITICALITY FUNCTIONS.
DOCUMENTATION	• PRODUCE/STORE DOCUMENTS PER SECURITY POLICIES.
C. M. PROCESS	• CONTROL/AUDIT ACCESS TO SOFTWARE PROCESSING SAFETY/SECURITY CRITICAL FUNCTIONS.
VERIFICATION	• DETERMINE VERIFICATION EFFORT PER CRITICALITY REQMNTS. • VERIFY BY RIGOROUS METHODS SAFETY/SECURITY/CRITICALITY FUNCTIONS ARE ANALYZED/DESIGNED/CODED CORRECTLY.

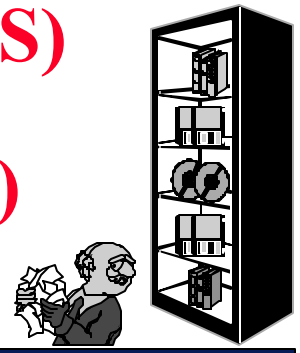
12207 MAY INVOKE OR MAY BE EXPANDED FOR SAFETY, SECURITY, CRITICAL STANDARDS

TESTING

- TESTING SHARED AMONG THE PARTIES

PROCESS	TESTING RELATED TASKS
ACQUISITION	• DEFINE ACCEPTANCE STRATEGY & CRITERIA. • PREPARE TESTS AND TEST ENVIRONMENT FOR ACCEPTANCE. • IDENTIFY TEST STANDARDS & PROCEDURES FOR CRITICAL REQS. • CONDUCT VALIDATION & ACCEPTANCE TESTING.
SUPPLY	• PLAN TEST ENVIRONMENT. • INTERFACE WITH IVV&T AGENT. • SUPPORT ACCEPTANCE & VALIDATION TESTING.
DEVELOPMENT	• DEFINE TESTS; PLAN AND DO TESTING: - UNITS, DATABASES, AGGREGATES - INTERNAL, INTEGRATION, QUALIFICATION, CONFORMANCE, INSTALLATION - INCLUDE STRESS TESTS AND TESTING • EVALUATE FOR TESTABILITY, TEST COVERAGE, TEST FEASIBILITY. • SUPPORT ACCEPTANCE TESTING.
OPERATION	• DEFINE OPERATIONAL TESTS. • TEST IN OPERATIONAL ENVIRONMENT. • CONDUCT OPERATIONAL TESTING FOR EACH RELEASE.
MAINTENANCE	• WHEN MODIFICATION, DO DEVELOPMENTAL TESTING. • TEST MODIFIED AND UNMODIFIED PARTS. • DO MIGRATION TESTING.
VALIDATION	• DEFINE AND CONDUCT VALIDATION TESTS. • INCLUDE STRESS TESTING.

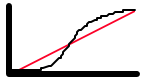
OFF-THE-SHELF SOFTWARE (OTSS)
&
NON-DELIVERABLE ITEMS (NDI)



PROCESS	OTSS & NDI RELATED TASKS
SCOPE	• 12207 IS NOT INTENDED FOR OTSS, UNLESS INCORPORATED INTO DELIVERABLES
ACQUISITION	• CONSIDER OTSS AS AN OPTION IN ACQUISITION OR PARTS OF ACQUISITION • ENSURE THE FOLLOWING IF ACQUIRING OTSS: - REQUIREMENTS ARE SATISFIED - DOCUMENTATION AVAILABLE - RIGHTS ARE SATISFIED - FUTURE SUPPORT PLANNED
SUPPLY	• CONSIDER OTSS IN DEVELOPMENT
DEVELOPMENT	• CONSIDER OTSS IN DEVELOPMENT [VIA SUPPLY PROCESS]. • NDI MAY BE USED IN DEVELOPMENT, - ENSURE OPERATION & MAINTENANCE INDEPENDENT OF NDI - OTHERWISE NDI SHOULD BECOME DELIVERABLE

METRICS & INDICATORS - I

• 12207 NEEDS THESE, BUT DOES NOT DEFINE OR PRESCRIBE THEM



PROCESS	METRIC/INDICATOR NEEDED
ACQUISITION	• PROCESS MONITORING - Cost, Schedule, Technical • SUPPLIER SELECTION - Capability, Past performance, ... • PROPOSAL EVALUATION - Technical, Cost, Schedule, Personnel, ... • AGREEMENT CHANGES - No., Rate, Impact, ... • ACCEPTANCE PROGRESS - Acceptance criteria, Conformance, Releasability, ... • JOINT ACTION ITEMS STATUS
SUPPLY	• BID DECISION • PROCESS MONITORING - Cost, Schedule, Technical • PROBLEM STATUS - By Activity/Task/Source, Trend, ... • ACCEPTANCE PROGRESS - Acceptance criteria, Conformance, Releasability, ... • JOINT ACTION ITEMS STATUS

METRICS & INDICATORS - II

• 12207 NEEDS THESE, BUT DOES NOT DEFINE OR PRESCRIBE THEM

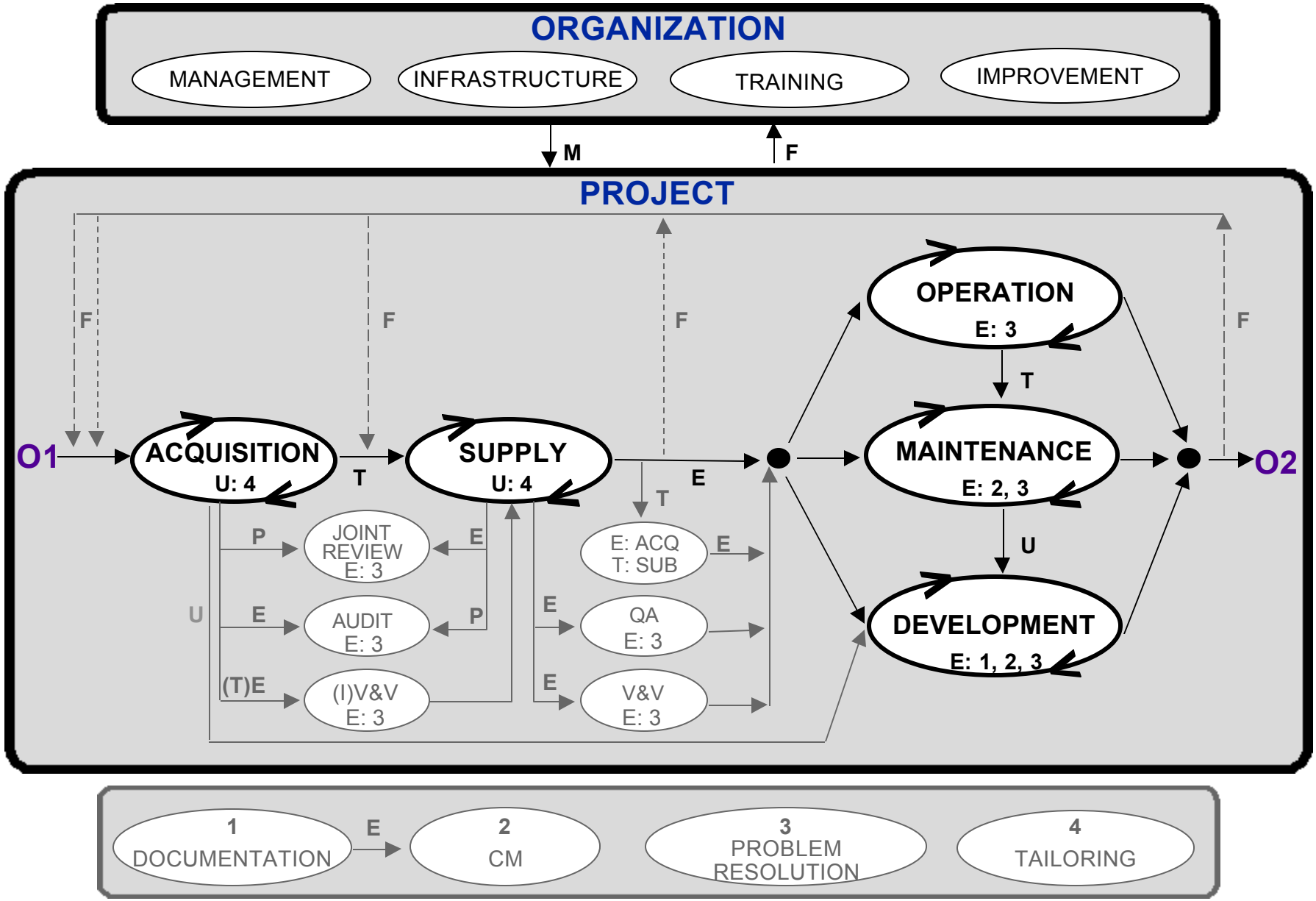
PROCESS	METRIC/INDICATOR NEEDED
DEVELOPMENT	• CHANGE STATUS: By Activity/Task, Source, Trend, ... • PROBLEM STATUS: BY Activity/Task, Source, Trend, ... • JOINT ACTION ITEMS STATUS • TRACEABILITY: - System Requirements to Acquisition Needs - System Architectural Design to System Requirements - Software Requirements to System Requirements & Design - Soft ware Architectural Design to Software Requirements - Software Detailed Design to Software Requirements - Software Unit to Software Requirements & Design - Software Design & Unit to System Requirements • QUALITY CHARACTERISTICS [ISO/IEC 9126] - Functionality, Reliability, Usability, Efficiency, Maintainability, Portability - Plus their sub-characteristics • REQUIREMENTS TESTABILITY STATUS • TEST COVERAGE • CONSISTENCY: INTERNAL & EXTERNAL • CONFORMANCE TO EXPECTED RESULTS • FEASIBILITY OF NEXT ACTIVITY • FEASIBILITY OF OPERATIONS • FEASIBILITY OF MAINTENANCE

METRICS & INDICATORS - III

• 12207 NEEDS THESE, BUT DOES NOT DEFINE OR PRESCRIBE THEM

PROCESS	METRIC/INDICATOR NEEDED
OPERATION	• OPERATIONAL CHARACTERISTICS - Run time, Throughput, Availability, Responsiveness, ... • OPERATIONAL TESTING - Coverage, Releasability, ... • USER SUPPORT - Status of requests, support, releases, ...
MAINTENANCE	• STATUS: PROBLEM REPORTS & MODIFICATION REQUESTS - Measure of classification, size, criticality, closure, ... - Impact on operations & maintenance • TEST COVERAGE OF - Modified parts - Unmodified parts • IMPACT ON UNMODIFIED PARTS • MIGRATION PORTABILITY • USER SUPPORT DURING MIGRATION • POST-OPERATION IMPACT OF MIGRATION • USER SUPPORT DURING RETIREMENT

PROCESSES and INTERACTIONS



O1: START HERE. **O1, O2 - THE SAME POINTS.** ACQ - ACQUISITION. SUB - SUBCONTRACTOR.
E - EXECUTE. F - FEEDBACK. M - MANAGE. P - PARTICIPATE. T - TASK. U - USE.
E:N - EXECUTE THE PROCESS N. U:N - USE THE PROCESS N.

PDCA

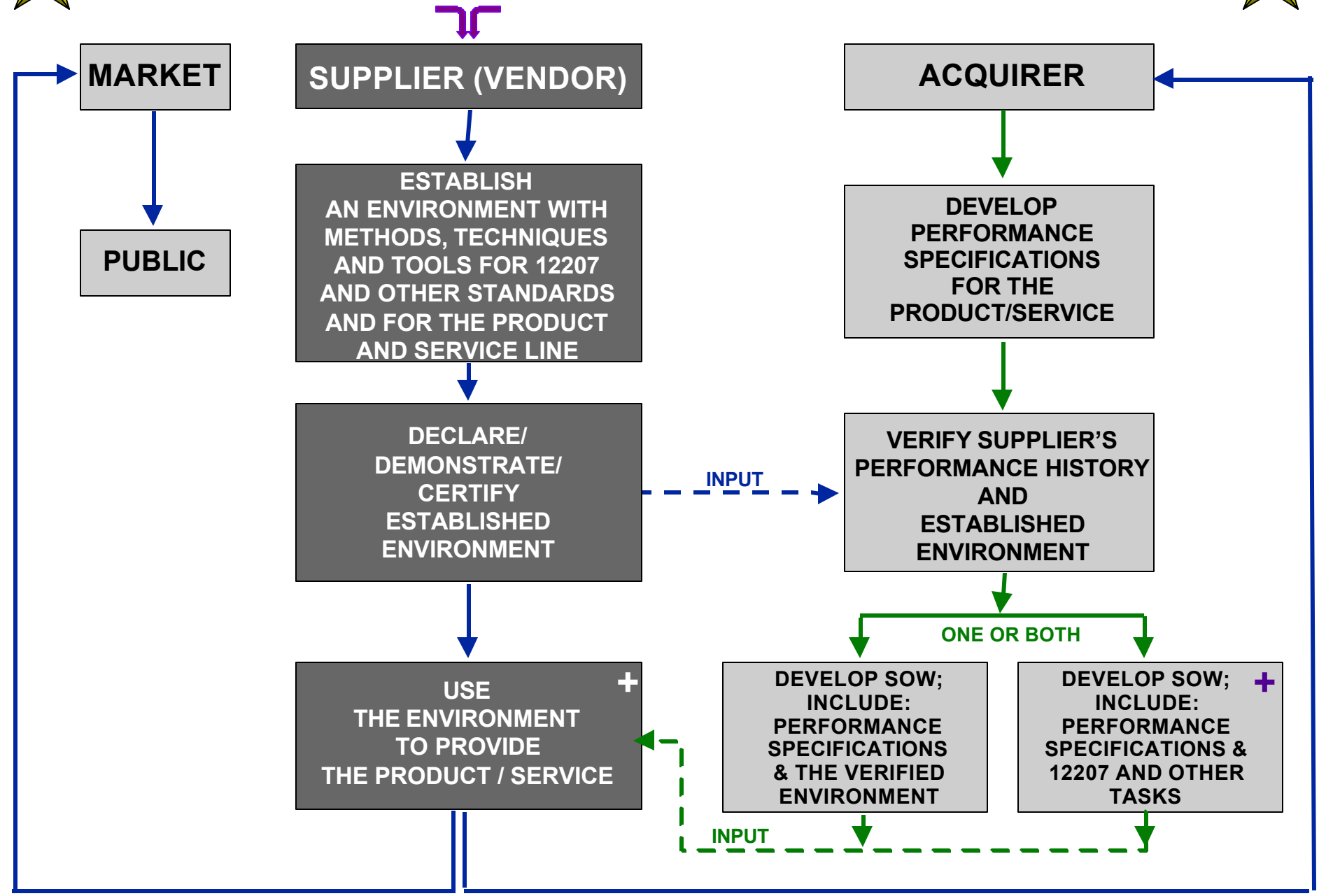
TOPICS

1. BACKGROUND
2. BASIC CONCEPTS
3. THE PROCESSES
4. **APPLICATION**
   - **Business practices under debate**
   - **How to use 12207 in an organization and on a project**
   - **Pertinent advice and notes**

   Note: No rules; only salient guidelines -- this presenter's

   Note: In charts, start at  **if shown**
5. **RELATED AREAS**
6. **SUMMARY**
7. **FOR YOUR INFORMATION**

BUSINESS PRACTICES UNDER DEBATE



\+ TO BE DISCUSSED AT THE NEXT CHART

+ USING ENVIRONMENT OR STANDARD ...
[From the previous chart]

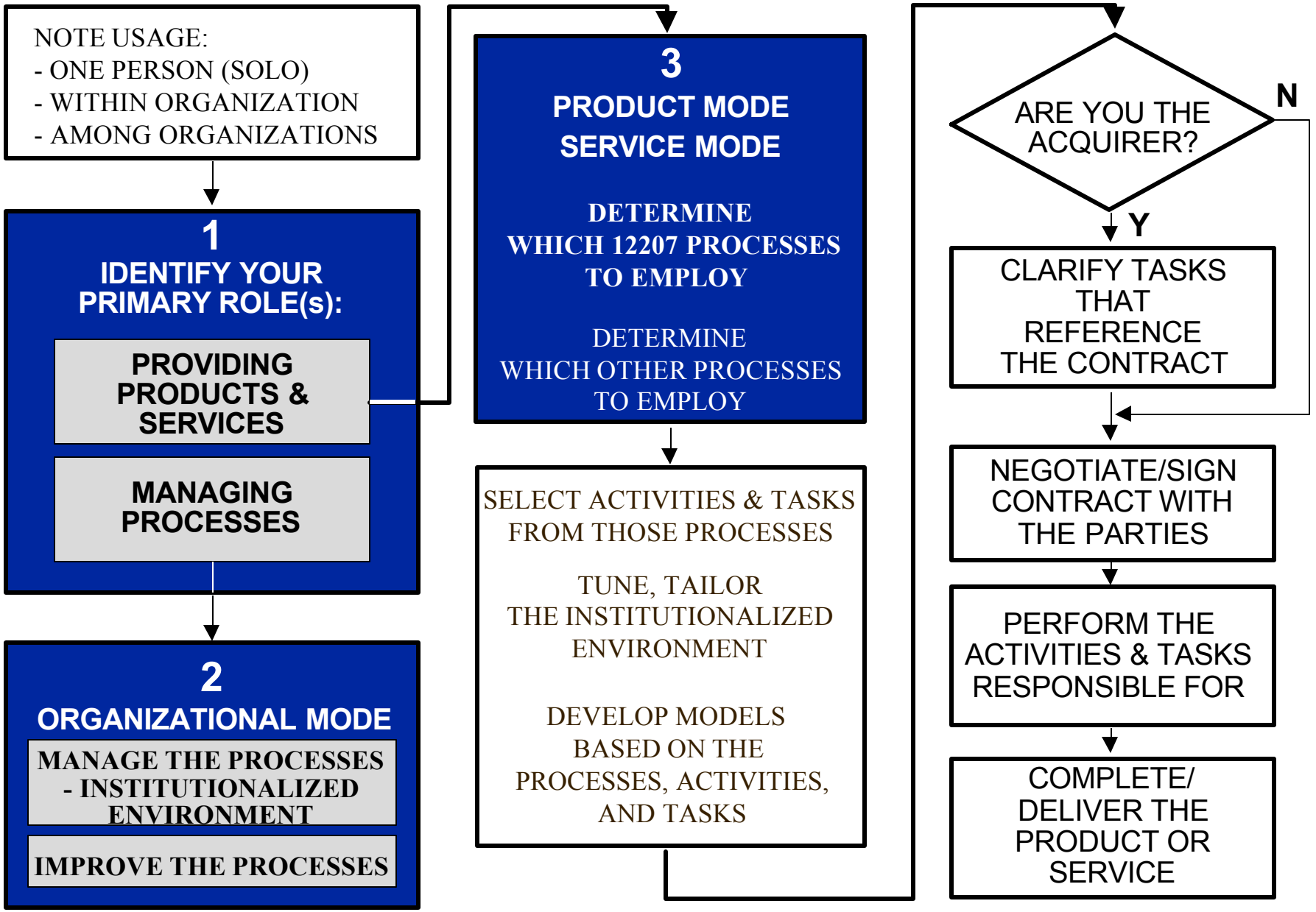
- **A *total* environment or the standard is general, complex, and large**
  - Outside of a project/service context, it would appear abstract
  - Using all of it would be neither cost-effective nor feasible.

- **Therefore, the environment or the standard should be tailored for the specific product/service. That is,**
  - Selecting the activities, tasks, inputs, and outputs
  - Selecting methods, techniques, and tools for the above

- **The following charts will discuss the factors [determinants] that should be helpful in:**
  - Selecting the activities and tasks for the product or service
  - Selecting methods, techniques, and tools for the above
  is left to down-the-road decision.

- **12207 will be used as a backdrop for selecting [tailoring] processes, activities, tasks, and outputs.**

GETTING STARTED



- **THE SHADED BOXES WILL BE EXPLAINED IN THE ORDER THEY ARE NUMBERED.**

APPLICATION STEPS AND FACTORS

[The shaded boxes 1, 2, 3 in Getting Started]

1. PRIMARY ROLES: Determine and identify

2. IN ORGANIZATIONAL MODE:

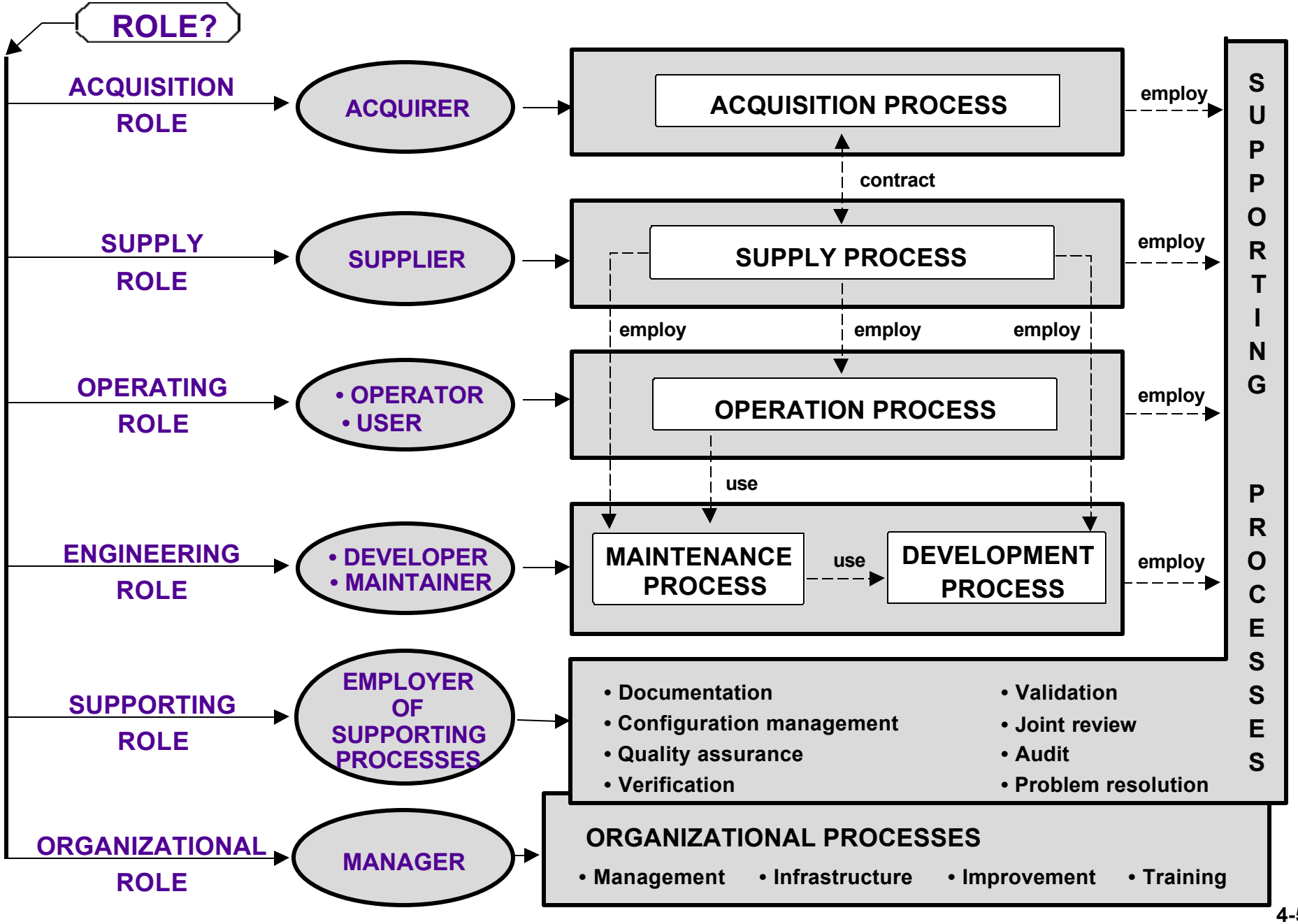
2.1	Process Management:	Establish the processes (and resources)
2.2	Process Improvement:	Improve the processes

3. IN PROJECT MODE:

3.1	Application Concepts:	Familiarize and understand
3.2	Policies:	Determine and identify applicables
3.3	Project Characteristics:	Determine and identify
3.4	System Context:	Select, determine, construct
3.5	Life cycle Models:	Determine and identify
3.6	Specialty Areas	Identify and supplement
3.7	Types of Software:	Determine and identify outputs
3.8	Documentation:	Determine and identify
3.9	Evaluation Categories:	Determine and identify

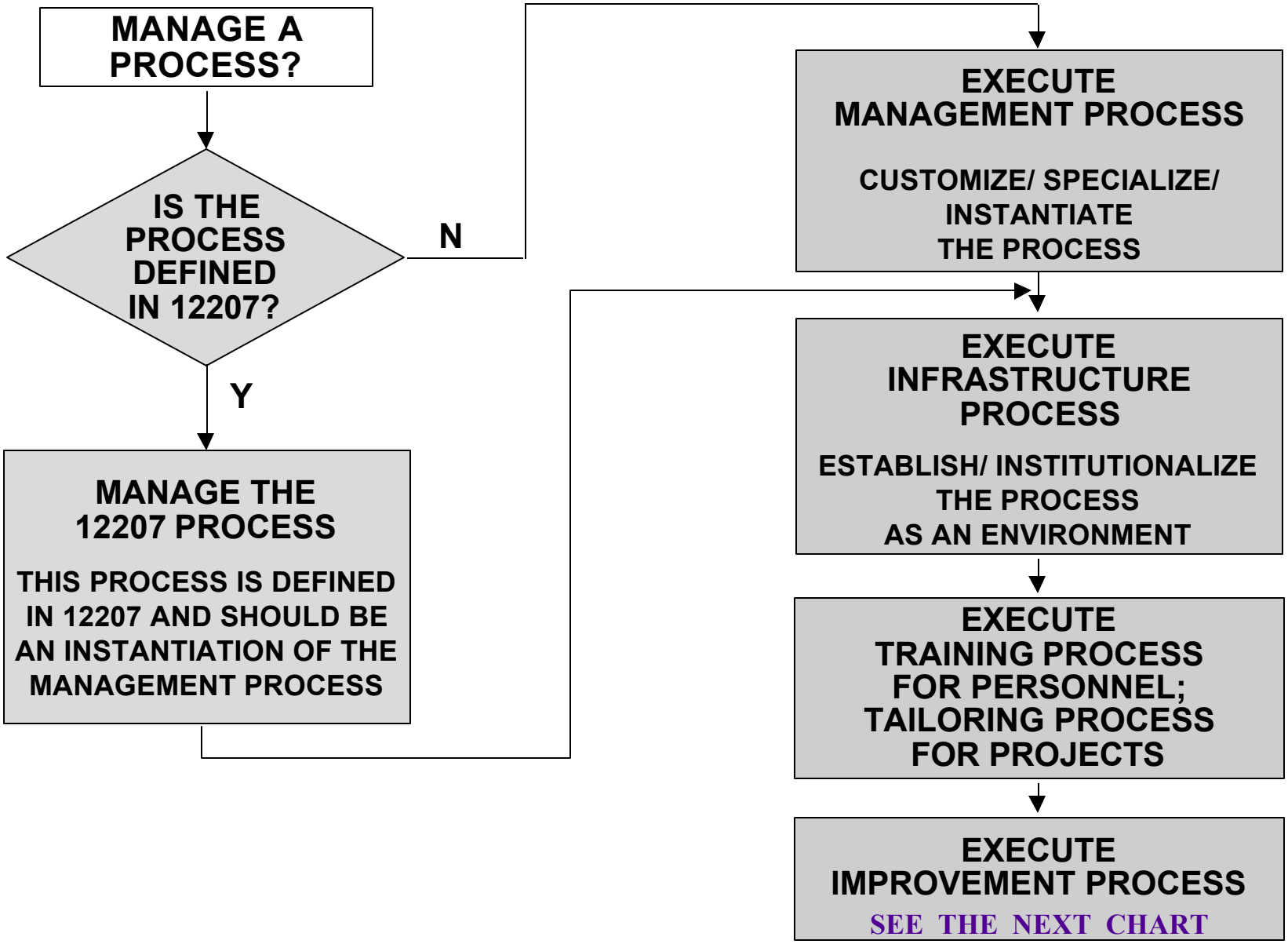
- **THE STEPS AND FACTORS ARE EXPLAINED NEXT AS OUTLINED ABOVE.**

1. PRIMARY ROLES
DETERMINE AND IDENTIFY



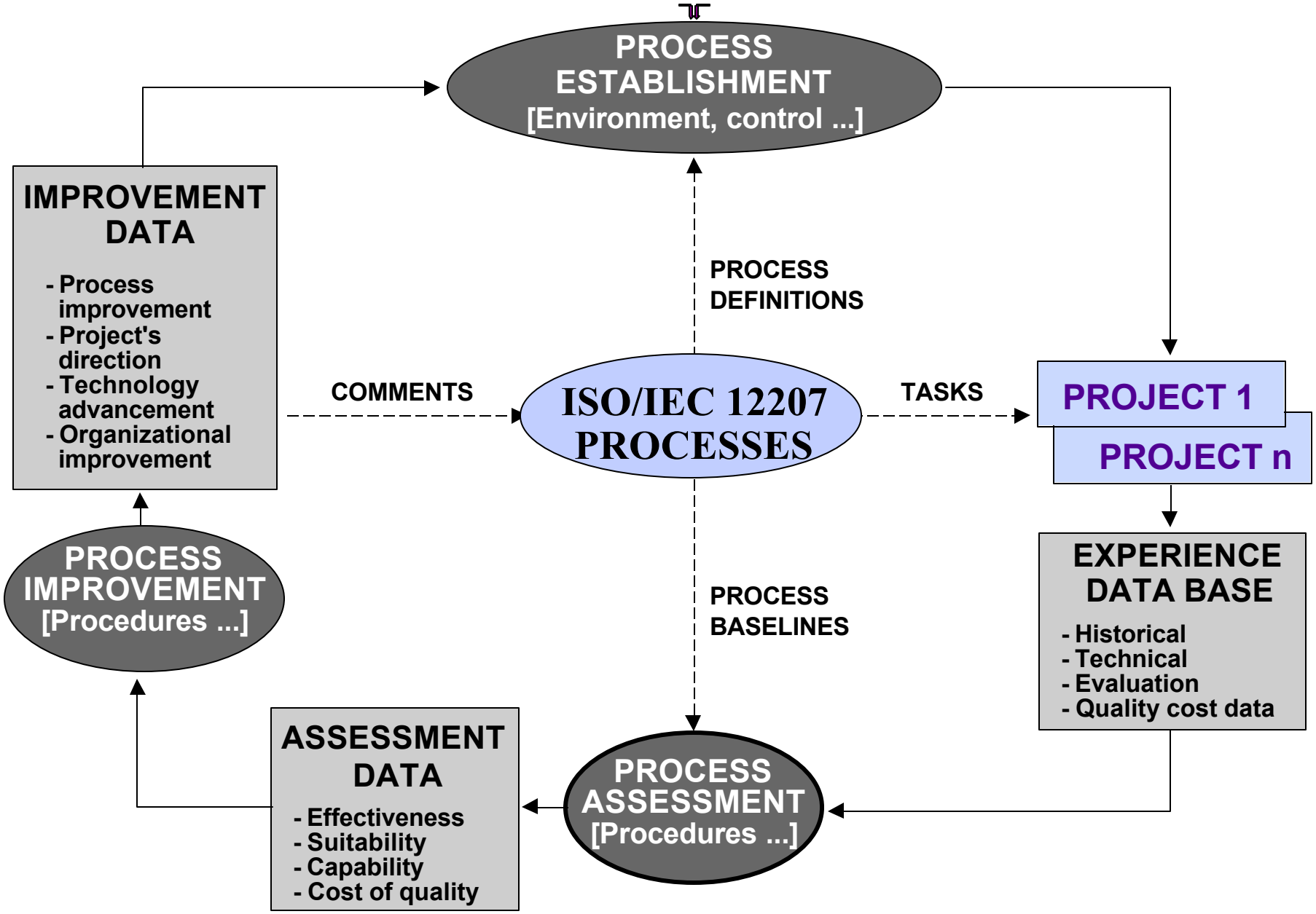
2.1 PROCESS MANAGEMENT

ESTABLISH THE PROCESSES



2.2 PROCESS IMPROVEMENT

IMPROVE THE PROCESSES



3.1 APPLICATION CONCEPTS
FAMILIARIZE AND UNDERSTAND

- **DUAL USE OF 12207:**
  - To develop, operate, and maintain application products
  - To use to analyze, model, or study a system
    - Whether or not the system would contain software.

- **LIFE CYCLE MODEL:**
  - To organize and manage the steps/phases of a life cycle in the desired order(s)
  - Incorporates developmental, operational, maintenance, ... models

- **PROTOTYPING IN 12207:**
  - Not listed as an activity of the Development or Maintenance
  - Treated as a method/technique for:
    - Performing studies, requirements analysis, design, etc.
    - Developing prototypes and mock-ups

- **BUILD:**
  - An instance of a product that meets a specified subset of the total requirements.
    - A build may be a prototype
  - A period of time during which the build is developed.

- **Iteration:** Iteration across activities.
  Recursion: "Iteration" across tasks in an activity.
  Note: Not every activity (task) needs to be executed in every iteration (recursion).

3.2 POLICIES

DETERMINE AND IDENTIFY APPLICABLES

- **CHECK POLICIES & STANDARDS AFFECTING TAILORING:**
  - Contract type(s): Fixed price; cost plus fee; etc.
  - Operations and support strategies
  - Documentation/data/interface standards
  - Safety, security, risk management
  - Programming language(s)
  - Reserve requirements
  - Measurement/metrics
  - Reuse
  - Proprietary, usage, warranty, escrow rights
  - Use of IV&V agents
  - ...
- **CHECK LAWS ON PUBLIC SAFETY, SECURITY, ENVIRONMENT, ...**
  - Consider, interpret, and incorpoarte clauses related to the above items
- **ADD CLAUSES IN AGREEMENT, IF NOT FOUND IN 12207**

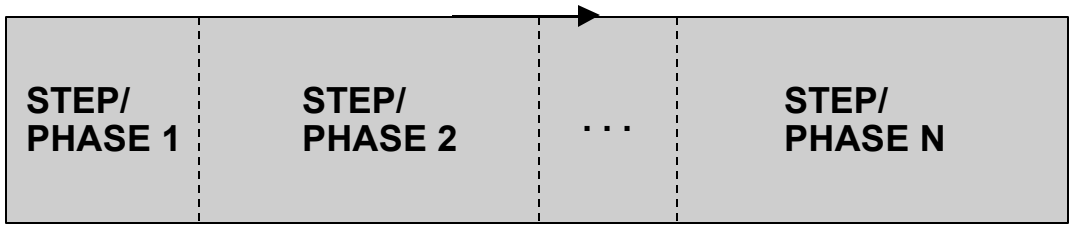
3.3 PROJECT CHARACTERISTICS
DETERMINE AND IDENTIFY

- **SIZE:** of software product, of software service, number of personnel
- **CRITICALITY:**
  - Impact of a defect/malfunction on business/mission
  - Liability due to failure
  - Immaturity or unprecedentedness of technology employed
  - Growth/changes in technology
  - Unprecedentedness of products under consideration
  - Unavailability of needed resources/schedule
- **LIFE:** Duration and extent of use and maintenance
- **AS SIZE OR CRITICALITY INCREASES, SO DOES:**
  - Extent of 12207's engineering tasks
    - Caution: Don't delete an engineering task unless sure
  - Extent of technical insight: [I]V&V
  - Extent of management visibility: Joint Review, Audit, QA
- **AS OBJECTIVITY BECOMES MORE IMPORTANT, SO DOES:**
  - Degree of independence of V&V Processes
  - Degree of organizational freedom for QA Process
  - Degree of independence in peer evaluations
- **AS LIFE OR EXPECTED CHANGE INCREASES, SO DOES:**
  - Extent of documentation
  - Caution: Consult with operators, users, and maintainers
- **NOTE:** Even for lesser size or criticality, independent or peer evaluations are beneficial

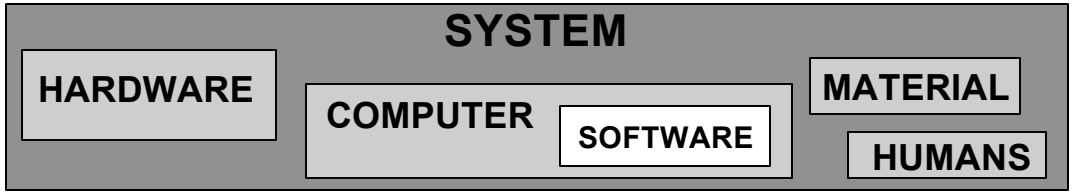
3.4 SYSTEM CONTEXT

DETERMINE AND IDENTIFY

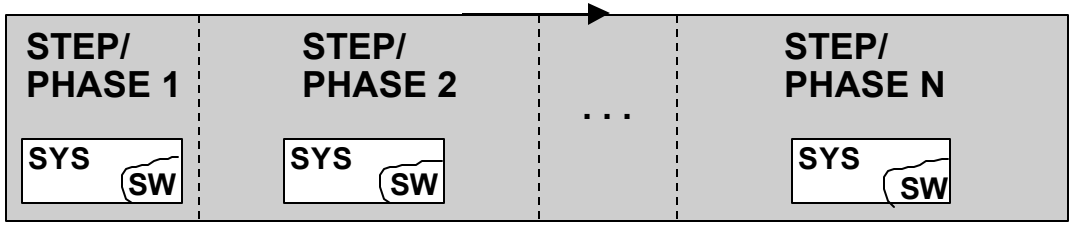
- **A system is moved from cradle to grave through steps/phases**



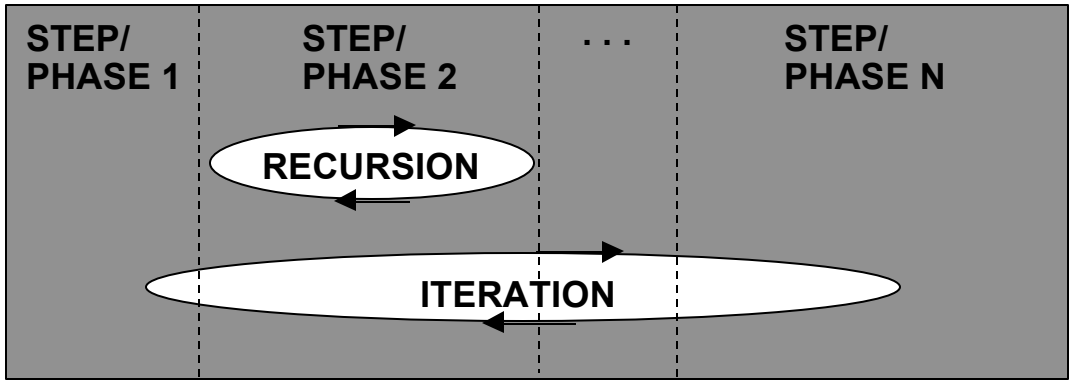
- **Software is one of many components in the system**



- **Software follows the system in each step/phase**



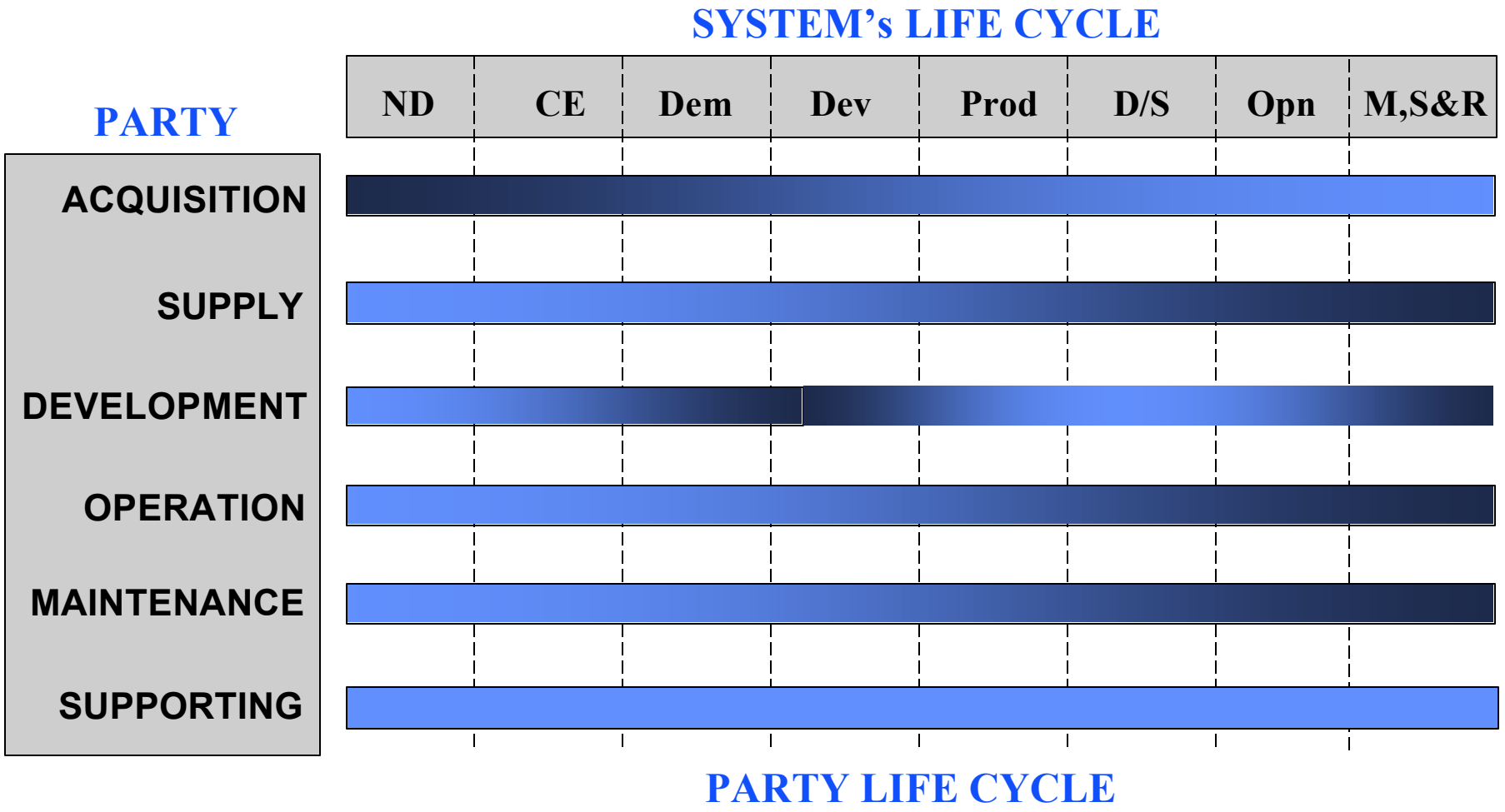
- **A project puts the steps/phases together:**
  - In the sequence
  - In the recursions
  - In the iterations
  - To the desired extend



3.4.1 SYSTEM LIFE CYCLE
[GENERIC; STATIC VIEW]

NEEDS DETERMINATION	DEFINE/DETERMINE NEEDS
CONCEPT DEFINITION	DEFINE CONCEPTS & SOLUTIONS
DEMONSTRATION	DEMONSTRATE FEASIBILITY OF IMPLEMENTING SOLUTIONS
DEVELOPMENT	DEVELOP PRODUCiBLE PRODUCTS
PRODUCTIONS; MANUFACTURING	PRODUCE; MANUFACTURE
DEPLOYMENT; SALES	DEPLOY AT SITES; SELL
OPERATIONS	OPERATE; USE PRODUCTS
MAINTENANCE & SUPPORT	MAINTAIN/SUPPORT PRODUCTS
RETIREMENT	RETIRE PRODUCTS

3.4.2 VIEWS OF LIFE CYCLE

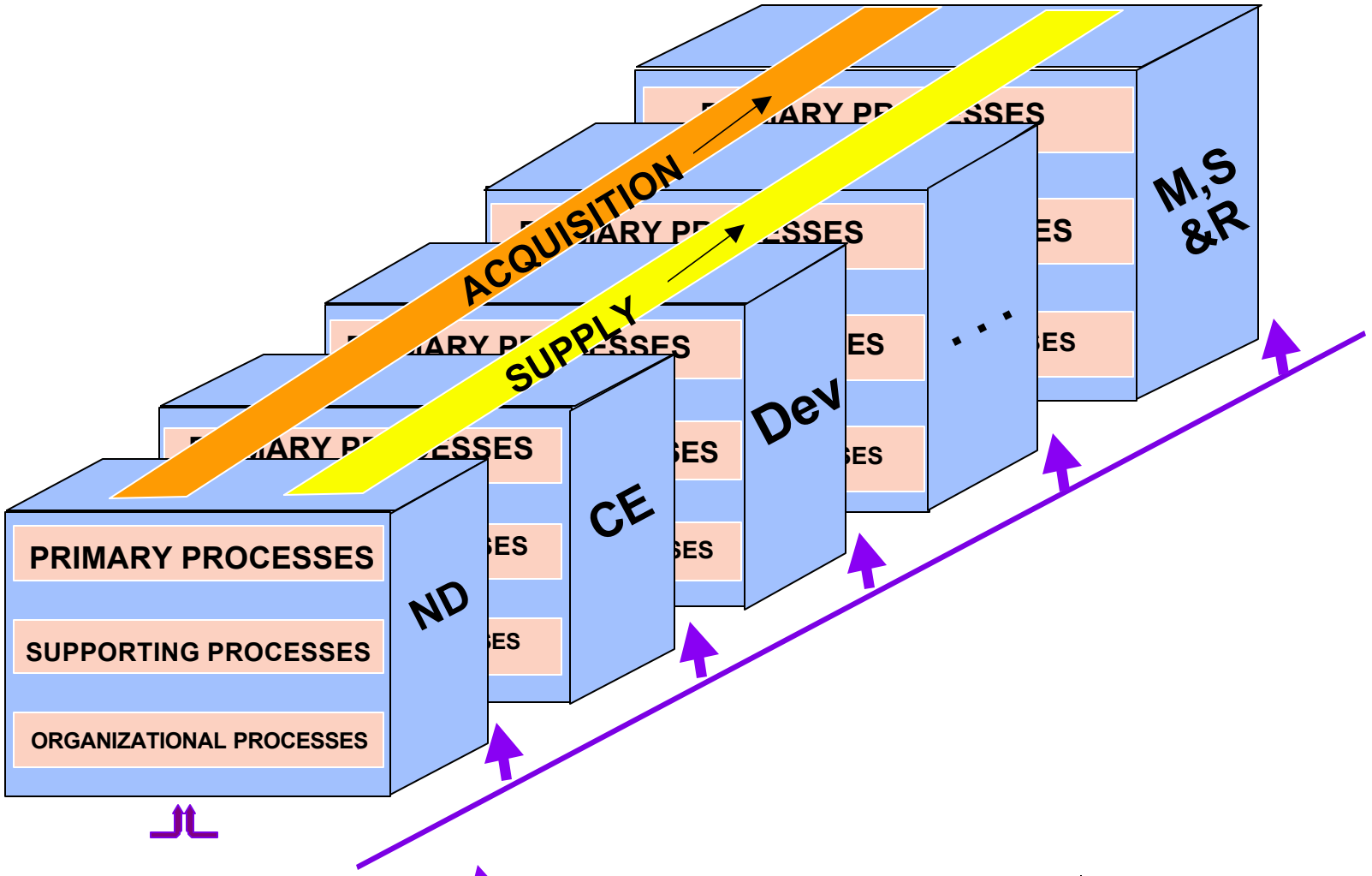


ND: NEEDS DETERMINATION
CD: CONCEPT DEFINITION
Dem: DEMONSTRATION
Dev: DEVELOPMENT

Prod: PRODUCTIONS
D/S: DEPLOYMENT/SALES
Opn: OPERATIONS
M,S&R: MAINTENANCE, SUPPORT & RETIREMENT

NOT TO SCALE

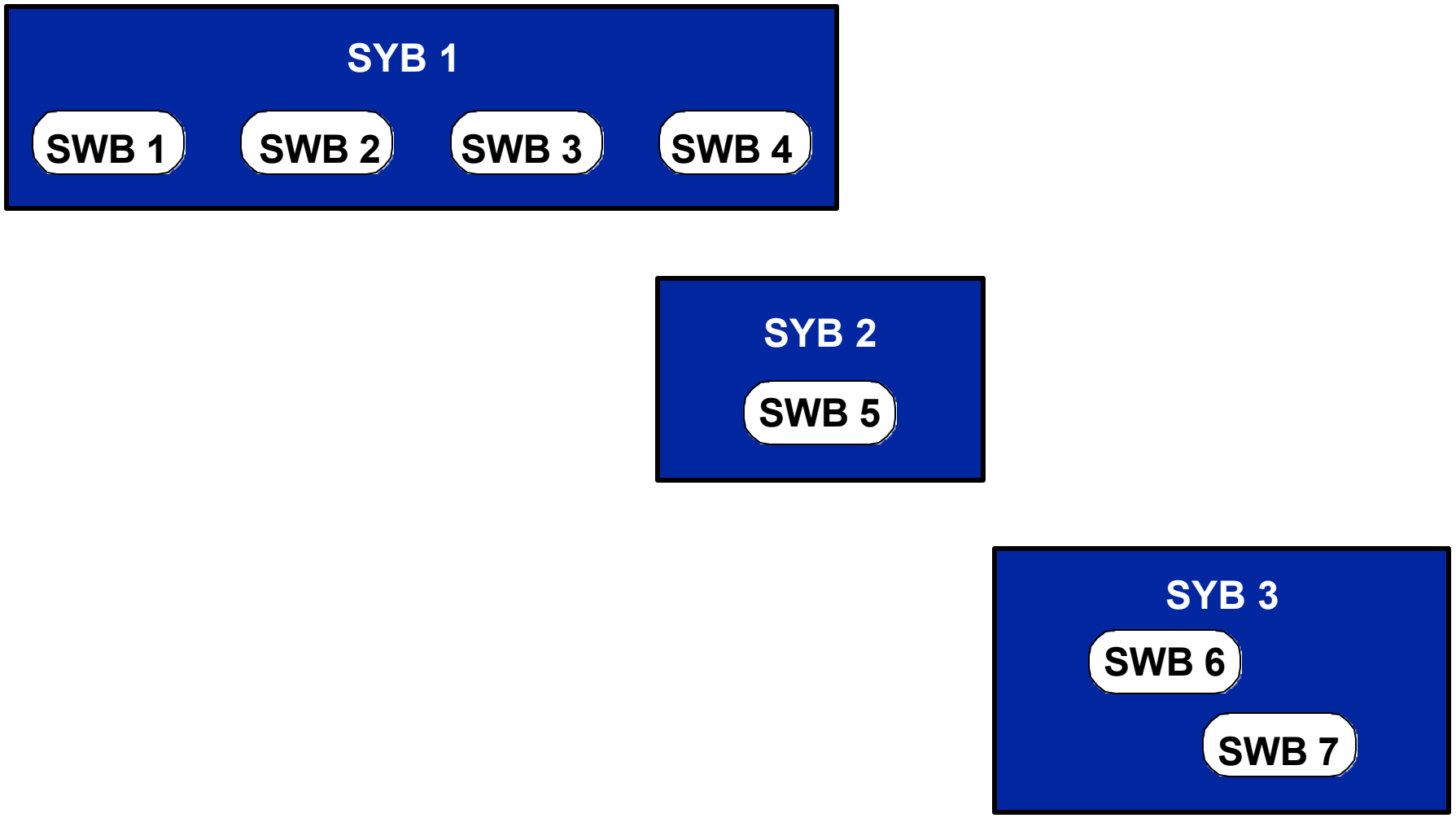
3.4.3 LIFE CYCLE DYNAMICS [MODELS]



LC DECISION POINTS:
- DO A NEXT PHASE
- HOLD PROJECT
- TERMINATE PROJECT
- CONTINUE CURRENT PHASE
- GO BACK TO A PREVIOUS PHASE

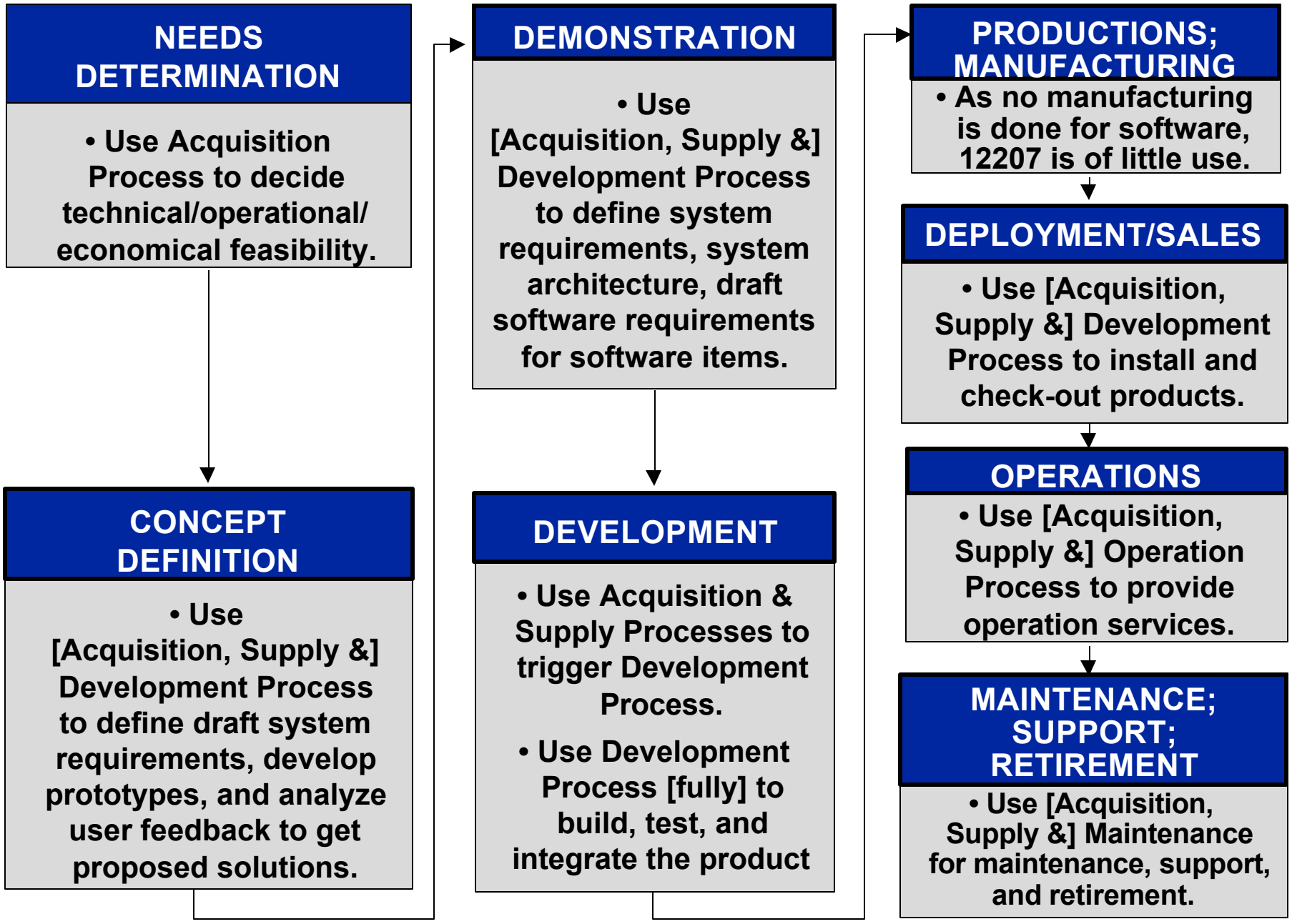
LC DECISION FACTORS:
- FUNDING & RESOURCES
- SCHEDULE
- FEASIBILITY
- TECHNOLOGY
- MARKET NEED

3.4.4 SYSTEM & SOFTWARE BUILDS



SYB = SYSTEM BUILD
SWB = SOFTWARE BUILD

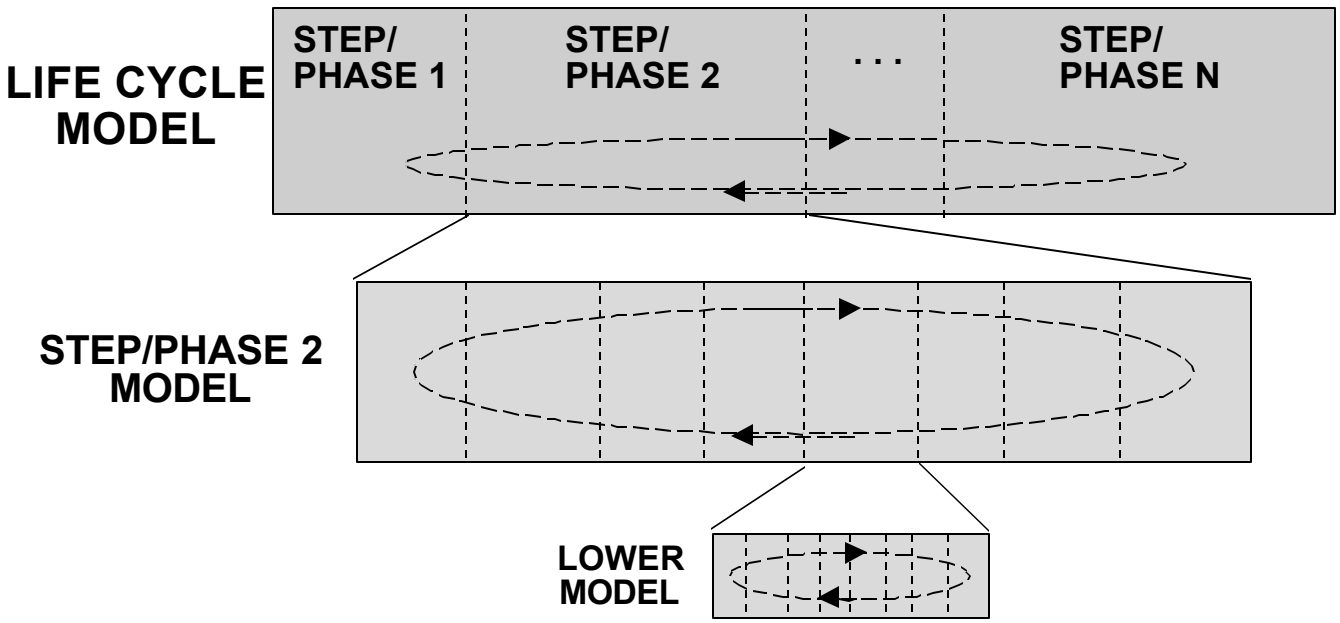
3.4.5 12207 IN SYSTEM LIFE CYCLE



3.5 LIFE CYCLE MODELS

SELECT, DETERMINE, CONSTRUCT

- **LIFE CYCLE MODELING IS A TOOL TO ORGANIZE/MANAGE THE STEPS/PHASES IN THE DESIRED ORDER**
- **A STEP/PHASE MAY HAVE ITS OWN MODELING**
  - Examples: Development, Operation, Maintenance, ...



- **ONLY [GENERIC] DEVELOPMENT MODELS WILL BE DISCUSSED NEXT.**
- **GENERIC OPERATIONS OR MAINTENANCE MODELS ARE NOT KNOWN.**

3.5.1 BASIC DEVELOPMENT MODELS

BASIC MODEL	ALL REQS. DEFINED FIRST?	MULTIPLE BUILDS?	USE INTERIM PRODUCTS?	REMARKS
WATERFALL	YES	NO	NO	BUILD N = BUILD 1
INCREMENTAL	YES	YES	MAYBE	BUILD N = BUILD (N-1) + MORE CAPABILITIES
EVOLUTIONARY	NO	YES	YES	BUILD N = BUILD (N-1) + REFINED SPECS.

- THE BASIC MODELS MAY BE COMBINED TO CREATE A HYBRID MODEL
- ITERATIONS AND RECURSIONS ARE PRESUMED

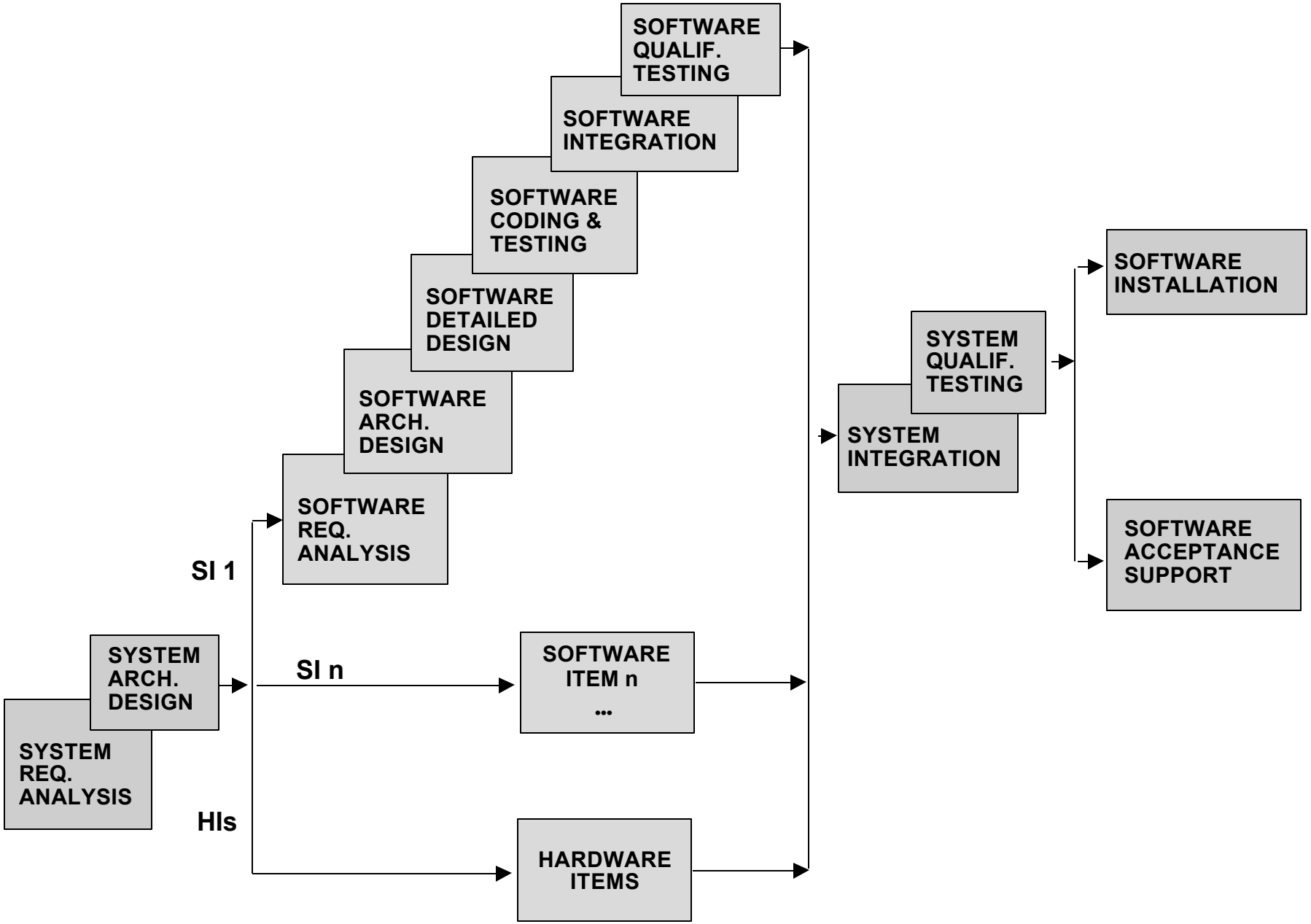
3.5.2 BASIC DEVELOPMENT MODELS

OPPORTUNITIES AND RISKS

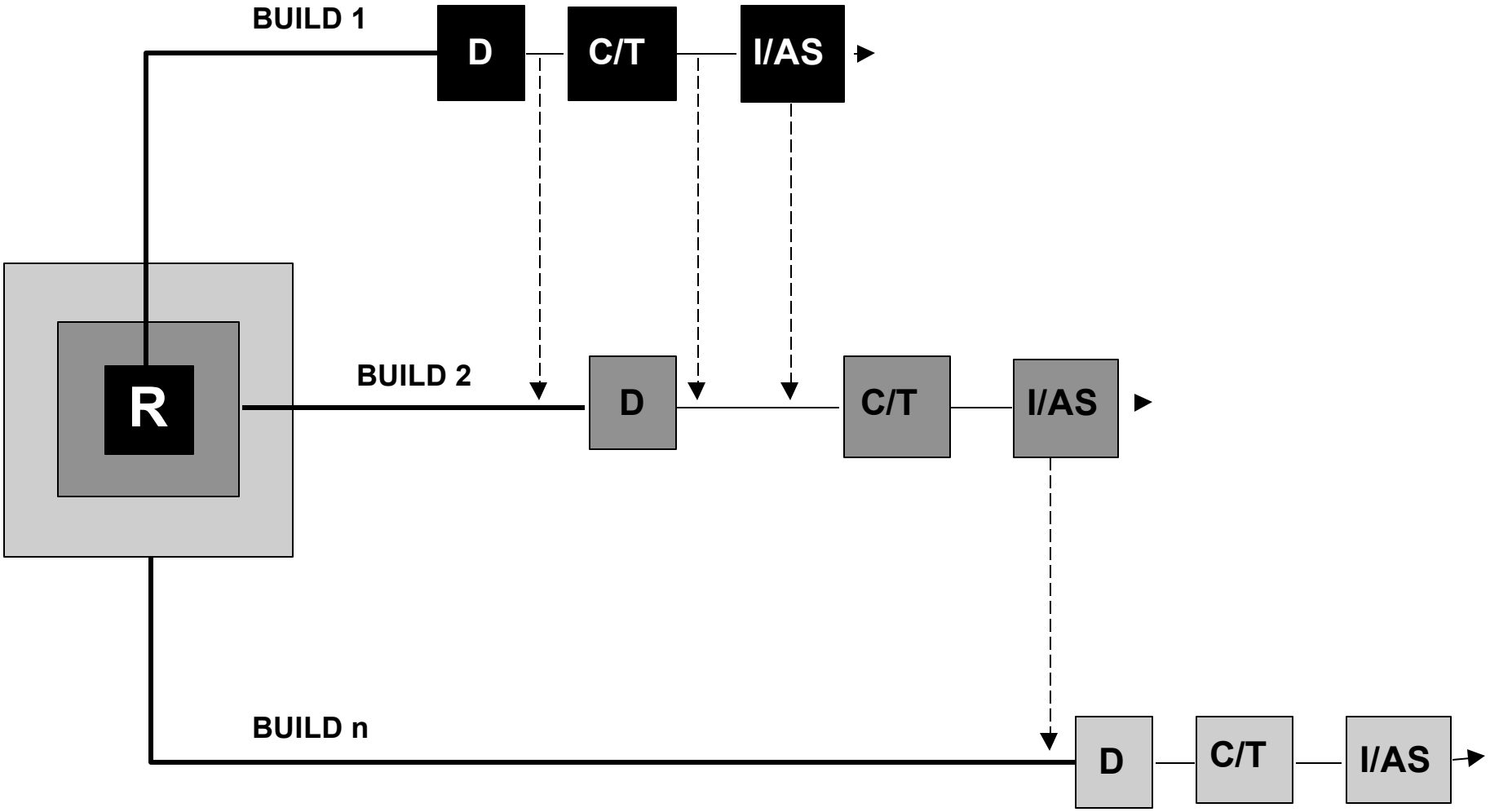
FACTORS	OPPORTUNITY	RISK
1. Requirements not well clear	E	W, I
2. System too large to do once	I, E	W
3. Full capability needed at once	W	I, E
4. Part capability needed early	I, E	W
5. Phase out of old system to be gradual	I, E	W
6. Rapid changes in requirements anticipated	E	W, I
7. Rapid changes in technologies anticipated	E	W, I
8. Long-run staff/funds commitment doubtful	W	I, E

W= WATERFALL; I= INCREMENTAL; E= EVOLUTIONARY
NOTE: A PROJECT MAY USE MORE THAN ONE MODEL.

3.5.3 DEVELOPMENT MODEL: WATERFALL



3.5.4 DEVELOPMENT MODEL: INCREMENTAL



FEEDBACK

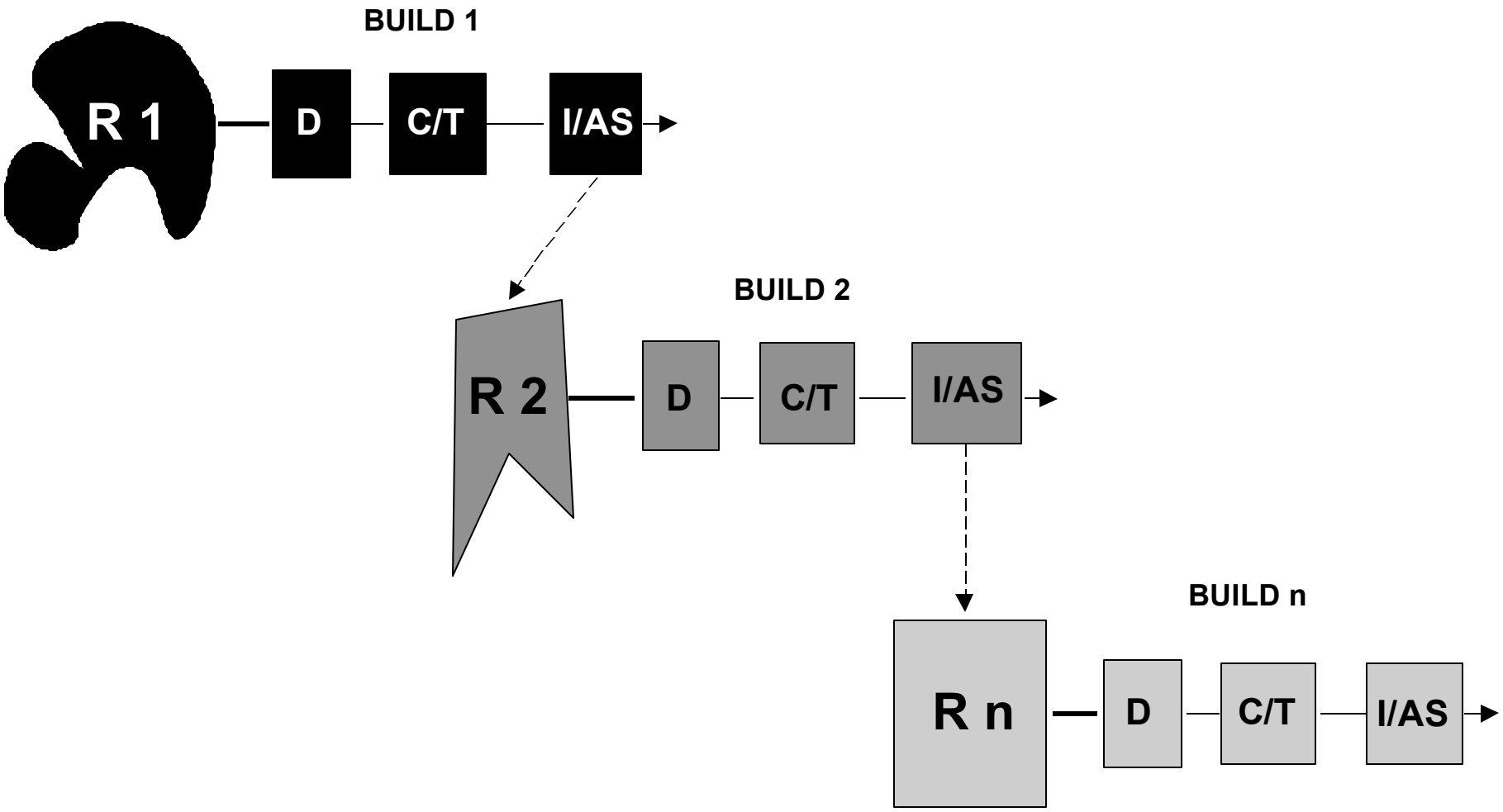
R: REQUIREMENTS

D: DESIGN

C/T: CODING & TESTING

I/AS: INSTALLATION & ACCEPTANCE SUPPORT

3.5.5 DEVELOPMENT MODEL: EVOLUTIONARY

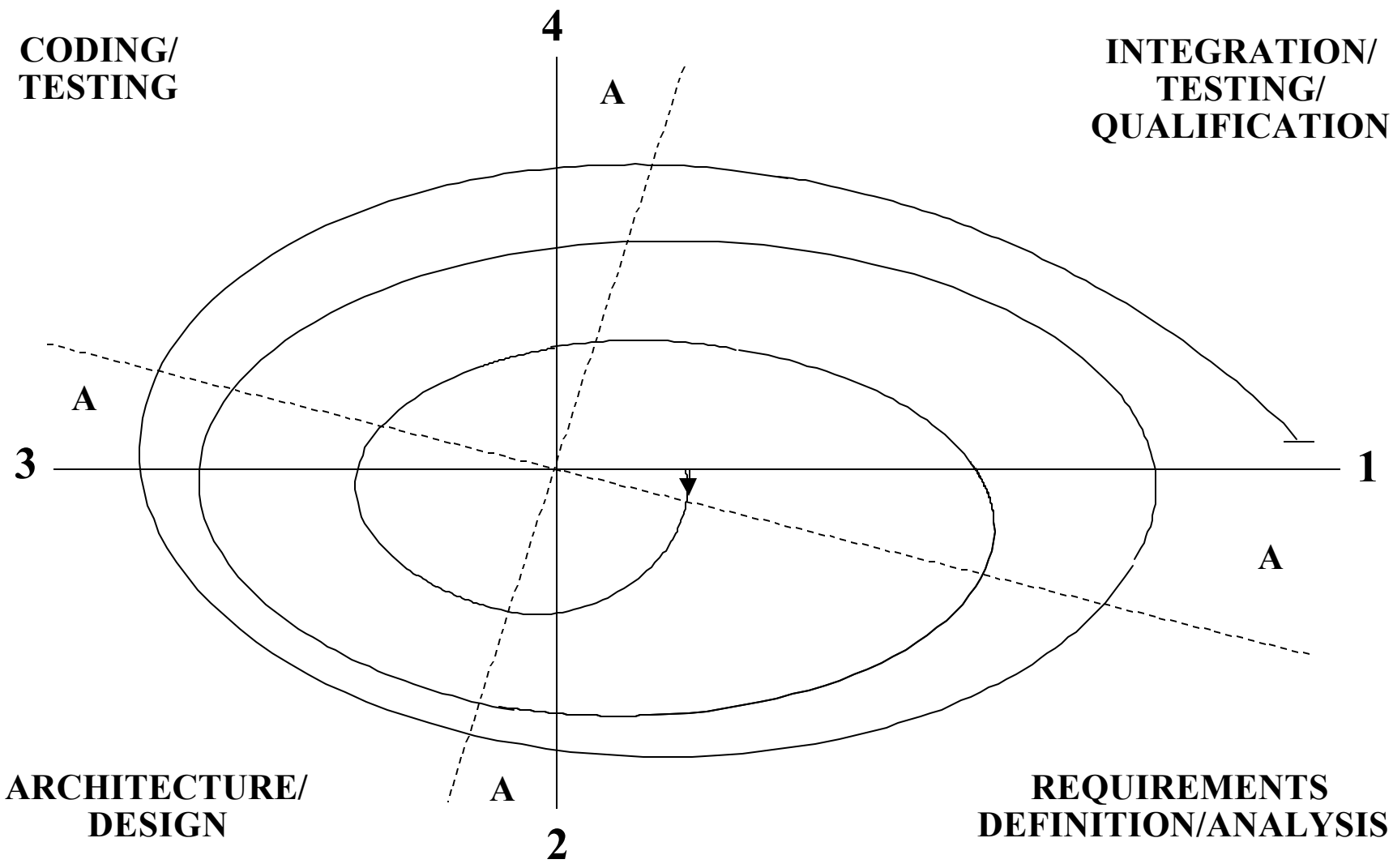


----------→ REFINEMENTS

R: REQUIREMENTS C/T: CODING & TESTING

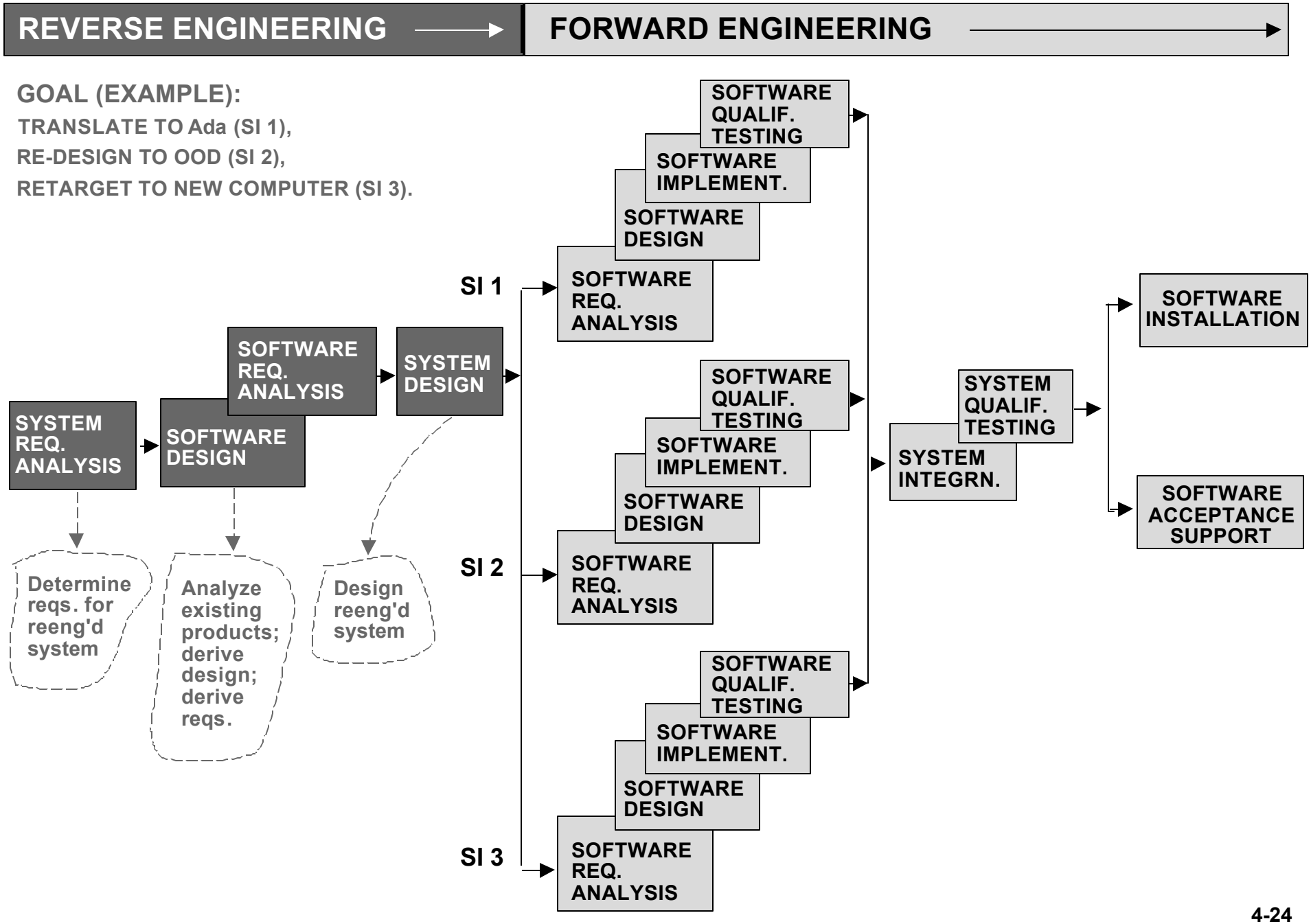
D: DESIGN I/AS: INSTALLATION & ACCEPTANCE SUPPORT

3.5.6 DEVELOPMENT MODEL: SPIRAL



- A: FEASIBILITY STUDY, PROTOTYPING, RISK ANALYSIS
- THIS MODEL ADOPTED FROM BOEHM's
- THE SECTORS MAY BE ALLOCATED TO THE 13 ACTIVITIES AS APPROPRIATE
- THIS MODEL IS REDUCIBLE TO THE BASIC MODELS
- MAY BE USED AS A HYBRID INCREMENTAL-EVOLUTIONARY MODEL

3.5.7 DEVELOPMENT MODEL: RE-ENGINEERING



3.6 SPECIALTY AREAS

IDENTIFY & SUPPLEMENT

- **SPECIALTY-AREA STANDARDS SHOULD BE USED WITH 12207**
  - Examples of specialty standards: safety, security, ergonomics, documentation, ...
  - Correlate terminology and concepts
    - Examples: coding v. implementation; architecture v. top-level design; ...
  - Determine supplementary tasks from the specialty standards for each 12207 process
    - Example: formal methods for design and verification, ...
  - Add the supplementary tasks to the 12207 tasks in respective clauses

- **EXAMPLE: SAFETY IN THE DEVELOPMENT PROCESS OF 12207**

TASK IN 12207	SUPPLEMENTARY TASKS FROM A SAFETY SPECIALTY STANDARD
Develop system architecture, ...	• Isolate safety specifications in separate configuration items.
Develop software architecture, ...	• Use structured design. • Isolate safety specifications in separate components/modules. • Use information hiding. • Derive design mathematically.
Develop code, ...	• Derive code by mathematically. • Use N-version coding resulting in voting modules.
Test units and aggregates, ...	• Exercise structural coverage [of branches and paths].
Document software requirements	• Document ... in Software Requirements Specification (SRS).

3.7 TYPES OF SOFTWARE
DETERMINE AND IDENTIFY

- **DIFFERENT TYPES OF SOFTWARE NEED DIFFERENT TREATMENT**
- **A PROJECT MAY HAVE MORE THAN ONE TYPE OF SOFTWARE**

CLASSIFICATION SCHEME - I	CLASSIFICATION SCHEME - II
APPLICATION: To monitor and control system functions - ATC, fire control, ... **SUPPORT:** To support users - Word processors, graphics, test generator, ... **SYSTEM:** To support computer operations - OS, Compiler, ...	**NEW DEVELOPMENT** **EMBEDDED** **INTEGRAL** Connected within/to a system **STAND-ALONE** Self-contained (viz., payroll) **OFF-THE-SHELF** Exists but not developed under the current project **NON-DELIVERABLE** Employed in the development/maintenance

- **NO DIFFERENCES IN APPLICATIONS OF 12207 FOR CLASSIFICATION-I**
- **APPLICATION OF 12207 FOR CLASSIFICATION-II TO FOLLOW NEXT**

3.7.1 TYPES OF SOFTWARE
OFF-THE-SHELF SOFTWARE

- **OFF-THE-SHELF SOFTWARE (OTSS):**
  - Software that is available from a source, but was not developed under the current application.
  - Source: In-house, another part of the organization, another organization, acquirer, market, …

- **HELPFUL POINTS:**
  - Consider the OTSS as a *new software* for the current application.
  - OTSS may or may not save costs.
  - OTSS may enhance or compromise design and performance.
  - Decide which activity the OTSS needs to enter.
  - Ensure the following, as applicable:
    - The OTSS satisfies its requirements & specifications
    - The documentation is available
    - Rights, warranty, licensing, and escrow are addressed
    - Future support for the OTSS is available.

3.7.2 TYPES OF SOFTWARE
NOTES ON REUSABILITY & PORTABILITY

- **REUSABILITY:** Extent of use in another application
- **PORTABILITY:** Extent of use in another computer system
- **REUSABILITY & PORTABILITY:**
  - Quality characteristics
  - Specified and designed
  - May have inherent conflict with other quality characteristics
  - Universal programming language ideal
- **A PROGRAM FROM ONE COMPUTER SYSTEM RARELY RUNS FIRST TIME ON ANOTHER COMPUTER SYSTEM.**
  - Few compilers adhere to standards exactly (have extra, improved features)
  - Word length varies from machine to machine
    - The largest integer varies. Different rounding off of numbers
  - Smallest positive floating point number depends on the machine
    - Drastic effect on "iterations until x < e"
  - 1's complement machine may give different results from 2's complement machine
  - Instruction length depends on OS
  - The program may not fit in the machine's memory; ...

"Never ever quite the same; nor ever quite another."

3.7.3 TYPES OF SOFTWARE
NON-DELIVERABLE ITEMS

- **NON-DELIVERABLE ITEM (NDI):**
  - A hardware or a software item that is not provided with the current application software, but is employed in its development or maintenance
  - Source: In-house, another part of the organization, another organization, acquirer, market

- **HELPFUL POINTS:**
  - For the suppliers: Approve and control all NDIs.
  - For the acquirers:
    - Decide whether the future operation or maintenance of the application software will depend on the NDI
    - Decide whether to "acquire" the NDI
    - Address rights, warranty, license, and escrow.

3.7.4 TYPES OF SOFTWARE
ENTRY POINTS, etc.

- ENTRY POINT (SUGGESTED) REFERS TO DEVELOPMENT PROCESS ACTIVITY
  - A PRIOR ENTRY POINT POSSIBLE
- TYPES TYPICALLY DETERMINED DURING REQUIREMENTS ANALYSIS AND DESIGN

TYPE	ENTRY POINT	REMARKS
NEW DEVELOPMENT	SYS. REQ. ANALYSIS	• Consider all activities.
EMPLOYING OFF-THE-SHELF AS IS	SW QUAL. TESTING	• Full Development Process may be excessive. • Evaluate documentation and data rights needs.
INCORPORATING OFF-THE-SHELF WITHOUT MODIFICATIONS	SW UNIT TESTING	• As in above • Based on performance record
ADAPTING/MODIFYING OFF-THE-SHELF	SW DESIGN	• Documentation may be unavailable/inadequate. • Evaluate documentation and data rights needs.
SOFTWARE OR FIRMWARE EMBEDDED IN OR INTEGRAL TO A SYSTEM	SYS. ARCH. DESIGN	• Decide if developer performs or supports system activities. • Determine support life and documentation needs.
STAND-ALONE SOFTWARE	SW REQ. ANALYSIS	• System activities may be excessive. • Determine support life and documentation needs.
NON-DELIVERABLE ITEM	CLAUSE 5.3.1.5	• Beware of impact on the operations and maintenance.

3.8 DOCUMENTATION
DETERMINE AND IDENTIFY OUTPUTS

- **REASONS FOR DOCUMENTATION (in 12207):**
  - Use in or across the same activity or process
    - Examples: Development plan; design;
    - Examples: Acquisition requirements; User manuals
  - Use in other projects
    - Examples: From development to maintenance; Reuse
  - Delivery to the acquirer
    - Examples: Operations manual; code
- **DETERMINE PRODUCTS/DOCUMENTATION:**
  - Which ones? -- Specifications; Design; ...
  - See the next chart for 12207's output categories
  - Format, Content, Media, ... ?
  - Use the Documentation Process of 12207
- **HELPFUL POINTS:**
  - Existing product standards usable with 12207
    - Correlate 12207 outputs with your product standards
  - Involve affected persons: especially users, operators, maintainers
  - Life cycle cost more critical than development cost
    - Over 70% of life cycle cost in maintenance

3.8.1 OUTPUT CATEGORIES

OUTPUT CATEGORY	12207 OUTPUTS
PLAN	ACQUISITION, PROJECT MANAGEMENT, DEVELOPMENT, TEST, INTEGRATION, INSTALLATION, OPERATION, MAINTENANCE, MIGRATION, RETIREMENT, CM, QA, VERIFICATION, VALIDATION, MANAGEMENT, INFRASTRUCTURE, TRAINING
REQUIREMENTS & SPECIFICATIONS	SYSTEM, HARDWARE, SOFTWARE, MANUAL OPERATIONS, TEST, SYSTEM QUALIFICATION, SOFTWARE QUALIFICATION
DESIGN	SYSTEM ARCHITECTURAL, SOFTWARE ARCHITECTURAL, SOFTWARE DETAILED, INTERFACE, DATA BASE
SOFTWARE CODE & DATABASE	SOFTWARE UNIT, DATABASE
TEST	TEST REQUIREMENTS & TEST RESULTS FOR UNITS, DATA BASE, SYSTEM/SOFTWARE QUALIFICATION, ACCEPTANCE, MAINTENANCE
MANUAL (USER'S)	FOR OPERATIONS AND MAINTENANCE
EVALUATION RESULT/REPORT	INTERNAL, QA, V&V, JOINT REVIEW, AUDIT, CM, PROBLEM RESOLUTION
SPECIAL	TAILORING DECISIONS

OUTPUTS IN A CATEGORY MAY BE COMBINED INTO ONE OR MORE SETS
EXAMPLE: DEVELOPMENT PLAN INCLUDES TEST, INTEGRATION, INSTALLATION AND CM

3.9 EVALUATION CATEGORIES
DETERMINE AND IDENTIFY

EVALUATION	OBJECTIVE
PROCESS INTERNAL	EXTENT TO WHICH MEETS SPECIFIED CRITERIA
VERIFICATION	VERIFY PRODUCTS IN AN ACTIVITY AGAINST PREVIOUS ACTIVITIES [DOING IT RIGHT] - Depth depends on criticality - Independence depends on objectivity
VALIDATION	VALIDATE AS-BUILT PRODUCTS FOR SPECIFIC INTENDED USE [DONE IT RIGHT] - Depth depends on criticality - Independence depends on objectivity
QUALITY ASSURANCE	ASSURE PRODUCTS & PROCESSES CONFORM TO REQUIREMENTS AND ADHERE TO PLANS - External - Organizational freedom and authority
JOINT REVIEW	REVIEW OF STATUS & PRODUCTS - Inter-party [Typically acquirer-supplier]
AUDIT	COMPLIANCE WITH REQUIREMENTS, PLANS AND CONTRACT - By authorized persons [acquirer or representative]
IMPROVEMENT	SELF-IMPROVEMENT OF PROCESS(es)

APPLICATION -- RECAP

- **WE DISCUSSED:**
  - **Role determination in a life cycle**
  - **Factors and determinants for selecting (and supplementing) processes, activities, and tasks**
    - **At project level**
    - **At organizational level.**

- **SUITABLE FOR EITHER BUSINESS PRACTICE OPTION:**
  - **Direct use of 12207 (including with specialty standards)**
  - **Use of an established environment (with 12207 as backdrop)**

- **HOPEFULLY, ACCOMMODATES DIVERSE PROJECTS, ORGANIZATIONS, AND COUNTRIES.**

- **NEXT, SOME ADVICE WILL BE GIVEN.**

ADVICE ON SPECIFICATION PRACTICES - I

- **Remember:**
  - Without specifications, there is no further work.
  - Specification mistakes are of commission and omission types.
  - A mistake in requirements/specifications that costs $1 to fix now would cost about $75 to fix during testing and more afterwards.

- **Software specifications are begun during system design**
  - There may be a "phase lag" between system and software.

- **Software [requirements and] specifications will change**
  - The challenge is in managing those changes.
  - Some changes can create an "earthquake" in software development.
  - Baselining [builds] is one way to control changes and impacts.
  - Incremental, evolutionary, and Spiral models may be helpful tools.

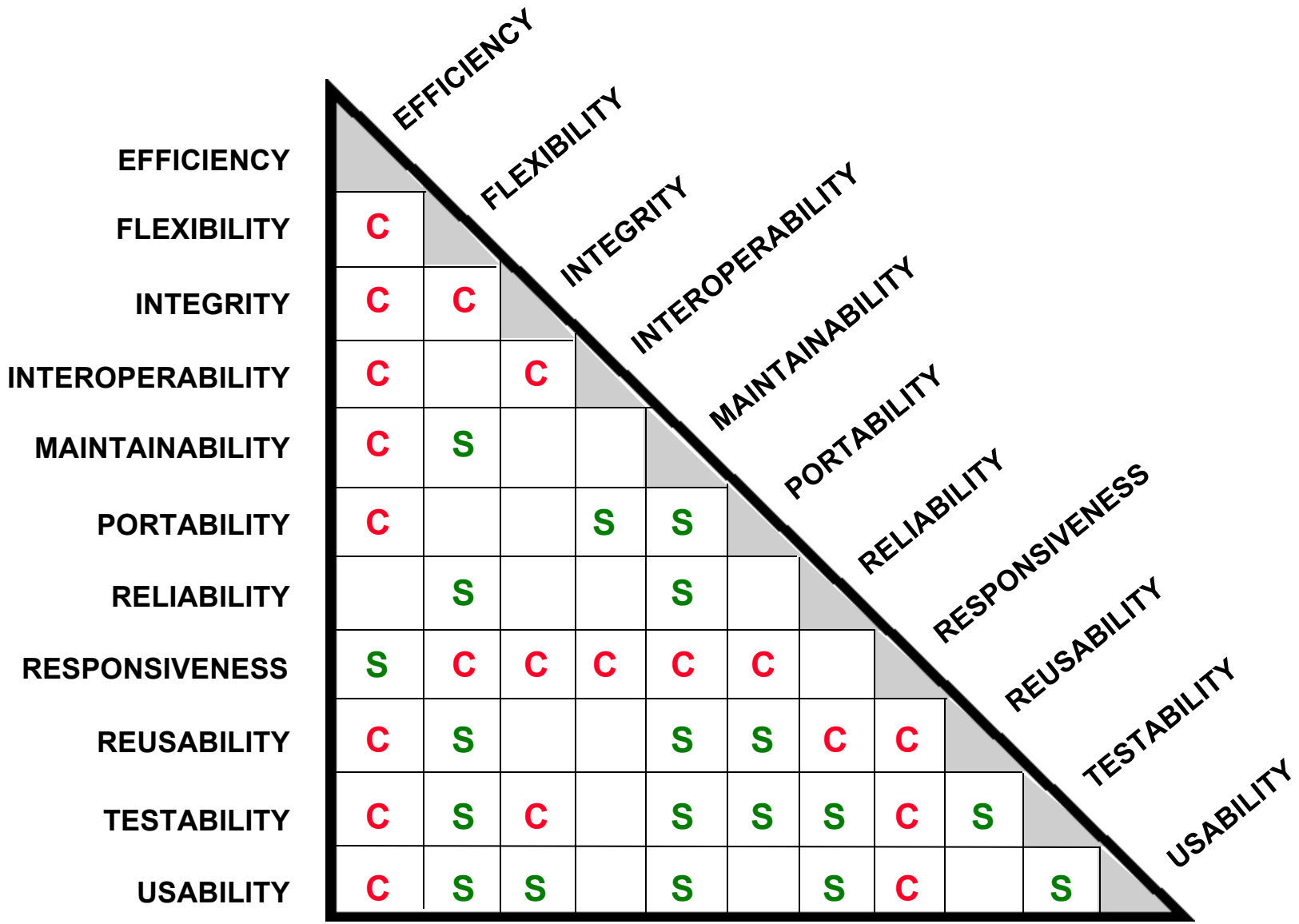
ADVICE ON SPECIFICATION PRACTICES - II

- **Make sure quality characteristics and lower characteristics are as completely specified as possible:**
  - Pay special attention to safety, security, and privacy.
  - Some quality characteristics may conflict with each other.
  - Prioritize the quality characteristics.
  - Caution: Software engineering may not be mature enough to design in several quality characteristics.

- **Besides what the system needs to do, specify the following:**
  - What the software must not do.
  - Execution behavior at non-normal inputs
  - Specifications of interfaces
  - Test cases and associated specifications, as needed
  - Constraints on design, interfaces, and test environment
  - Target environment, as much as possible

- **Use specification language, techniques, and tools**

QUALITY FACTORS [CHARACTERISTICS]



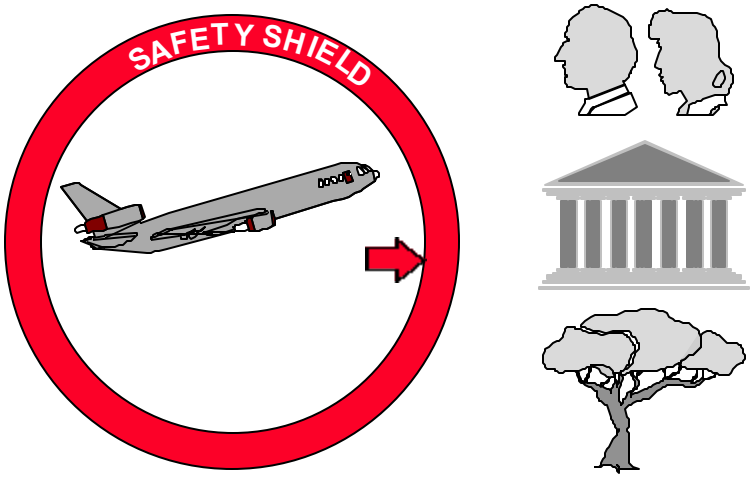
C: CONFLICTING; S: SUPPORTING; BLANK: NO RELATIONSHIP

Source: James McCall

SAFETY, SECURITY, RELIABILITY

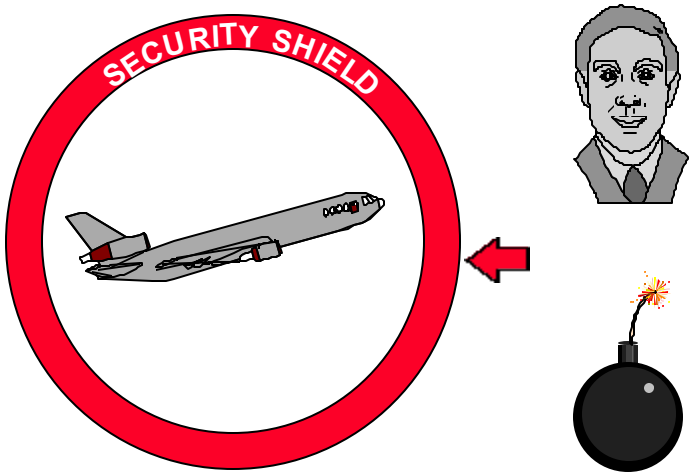
SAFETY

PREVENTING THE SYSTEM FROM DAMAGING ITS EXTERNAL WORLD



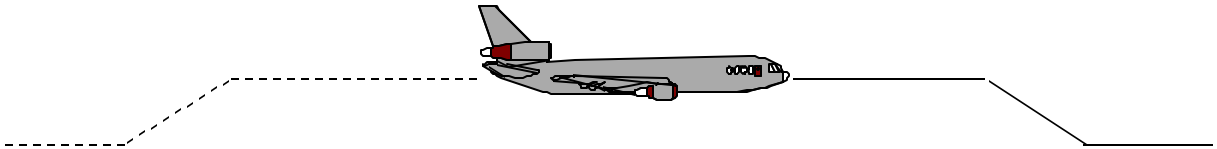
SECURITY

PROTECTING THE SYSTEM FROM DAMAGE BY ITS EXTERNAL WORLD



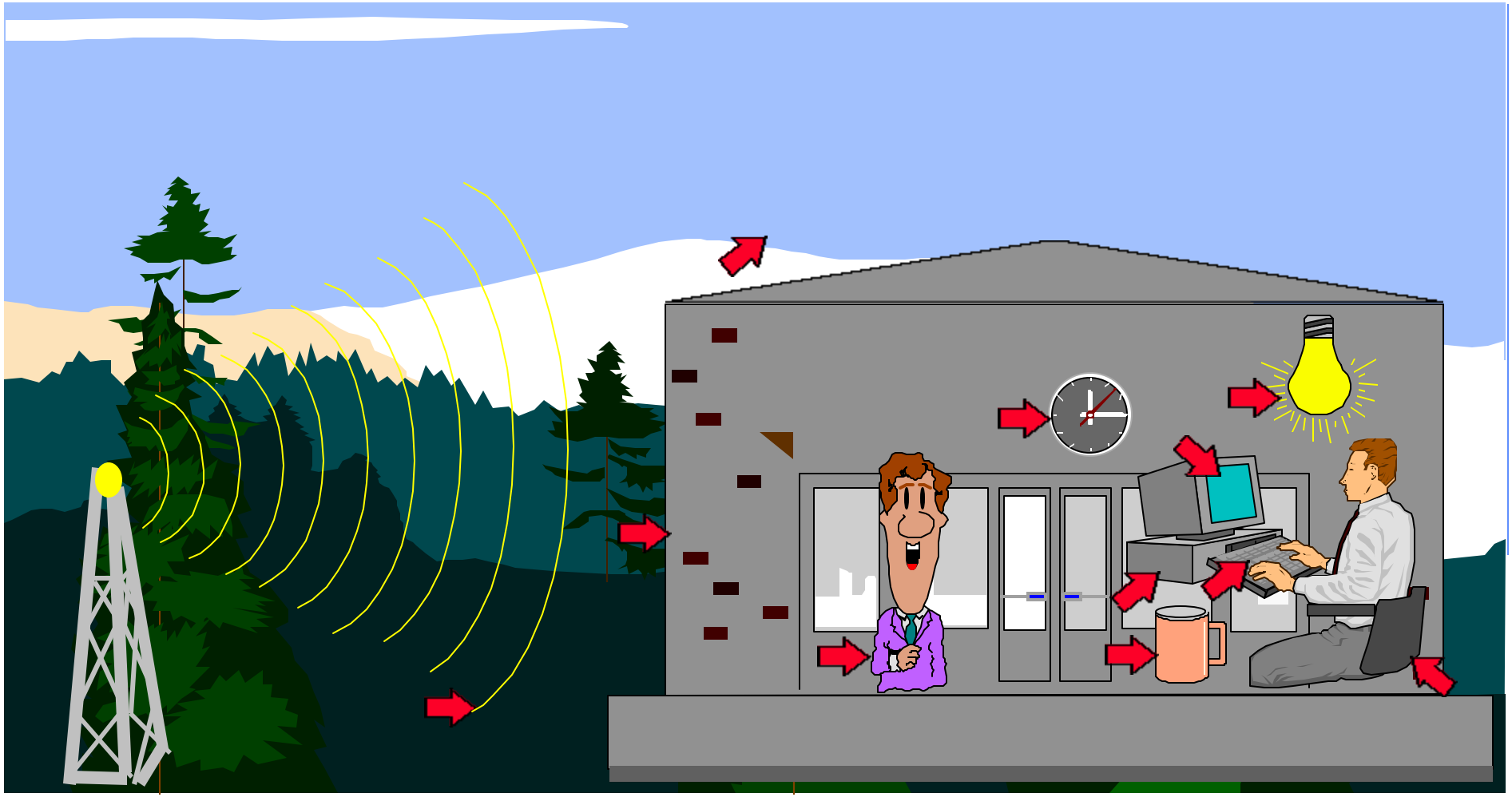
RELIABILITY

ASSURANCE THAT THE SYSTEM WILL PERFORM AS INTENDED.



ENGINEERING EQUIPS THE SYSTEM WITH THE ABOVE FEATURES.

ERGONOMICS
HUMAN WORKING



- **FACTORS AFFECTING WORKING HUMANS (EXAMPLES):**
  - **ENVIRONMENTS -- NATURAL, ARTIFICIAL, WORK**
  - **CAPABILITY: PHYSICAL AND MENTAL**
  - **FELLOW WORKERS; EQUIPMENT; AUTOMATION**
  - **LIGHTING, CONSOLE, SCREEN, DESK, CHAIR, TIME, FOOD, et.al.**

ADVICE ON TESTING - I
CONTEXT

- **A programmer describes a system function to a *digital* computer in "precise" instructions.**
- **What a programmer thinks s/he instructed the computer to do and what the computer understands it has been instructed to do are *rarely* the same.**
- **A program works in digital space, which is discrete and not finite.**
- ***Completeness of testing*:**
  - It is impractical, if not impossible, to cover the digital space completely by testing.
- ***Adequacy of testing*:**
  - The magic is in covering the digital space adequately, but judiciously and cost-effectively.
- **Do not depend on testing only to gain confidence. Use analysis, inspection, and demonstration as well.**

ADVICE ON TESTING - II
ADEQUACY OF TESTING

- **Modularize**
  - Follow the rules and schema of modularization.
  - Ensure correct order and passing of parameters.
- **For each module and aggregate, compare "line-by-line" outputs with manual calculations for certain input values:**
  - Normal -- educated, representative points
  - Non-normal: Boundaries; Discontinuities; Singularities; +/- delta
  - Smallest and largest numbers allowed by the computer.
- **Note: The above must be accommodated by design and in code.**
- **Execute with global initializations: Zero; Infinity.**
- **Cover McCabe's basic paths.**
- **Compare runs with special/deduced/known cases.**
- **Remember: A modification may introduce new errors.**
- **When a module is modified, ensure other modules are not affected.**
- **Employ a suitable reliability growth model to determine releasability.**
- **Include information on the computer, OS, language, and compiler.**

TOPICS

1. BACKGROUND
2. BASIC CONCEPTS
3. THE PROCESSES
4. APPLICATION
5. **RELATED AREAS**
6. SUMMARY
7. FOR YOUR INFORMATION

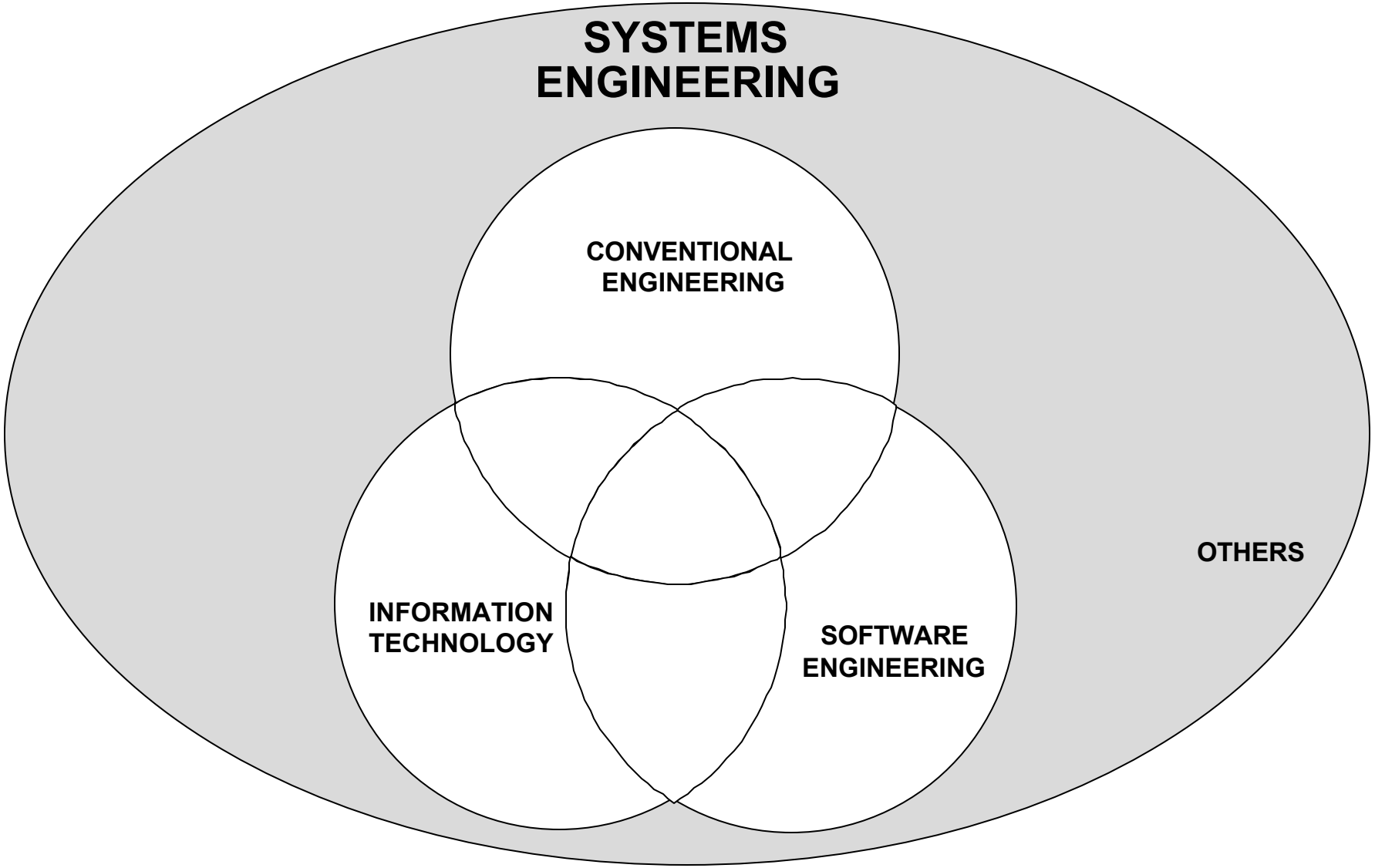
REFERENCED STANDARDS

REFERENCED STANDARD	REFERENCED AS	REASON FOR REFERENCING
AFNOR: Dictionary of Computer Science	Normative	Definitions
ISO/IEC 2382-1	Normative	Definitions
ISO/IEC 2382-20	Normative	Definitions
ISO 8402	Normative	Definitions
ISO 9001	Normative	Additional guidance on quality systems [see clause 6.3]
ISO/IEC 9126	Normative	Guidance on quality characteristics [see clause 5.3.4]
ISO/IEC 12119	Bibliography	Software packages

SUPPLEMENTARY STANDARDS

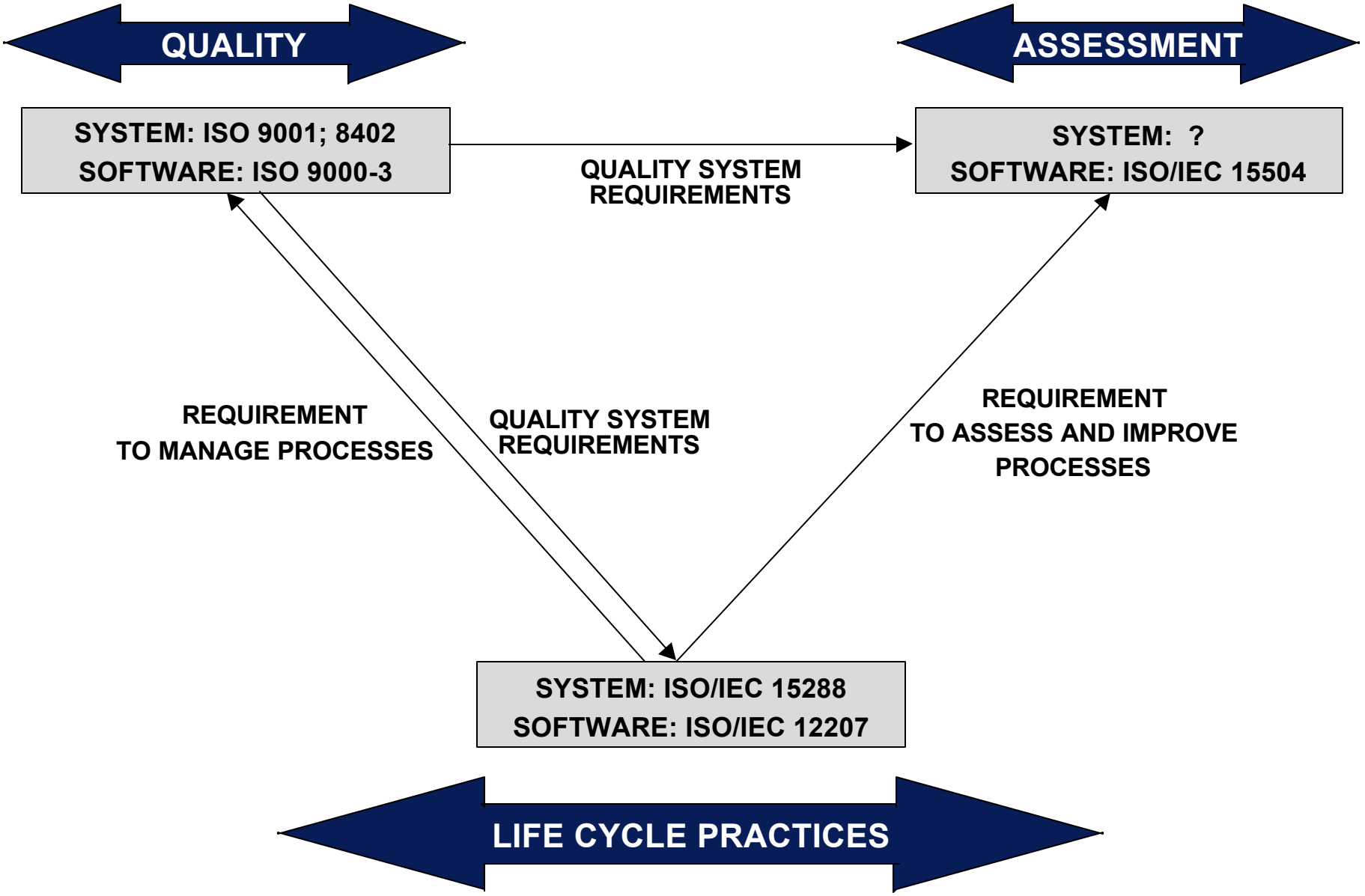
STANDARD	STATUS
Technical Reports (TR): - ISO/IEC 15271, 12207 Guidebook - ISO/IEC 14759, Mockup & Prototype Guide	 - Under publication - TR Ballot Passes
Standard: ISO/IEC 14764, Software Maintenance	Under FDIS BALLOT
Standard: ISO/IEC 15846, Software CM	Published
Guide: ISO/IEC 16326 Software Project Management	CD
Guide: Software QA	Canceled in favor of ISO 9000-3
Guide: Software V&V	On hold
Guide: Reviews & Audits	On hold

RELATIONSHIP TO SYSTEM AREAS



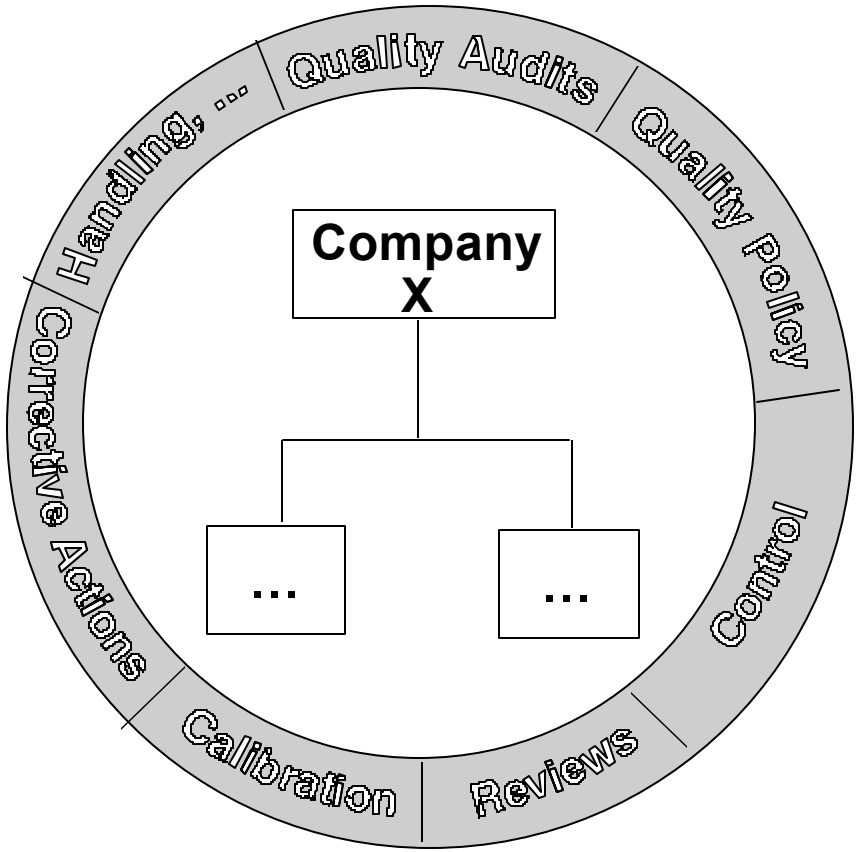
NOT TO SCALE; NOT EXHAUSTIVE

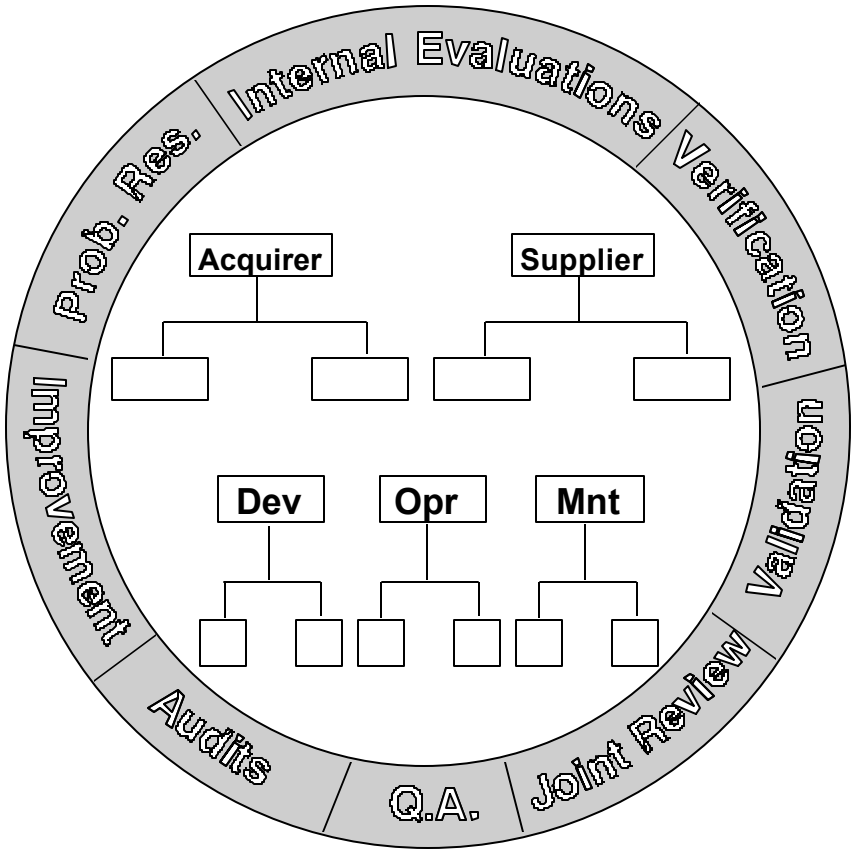
RELATIONSHIP TO QUALITY AREAS



COMPARISON WITH ISO 9001

ISO 9001 ←----- **ISO 8402** -----→ **ISO/IEC 12207**





CORPORATE VIEW OF QUALITY
QUALITY SYSTEM -- CONSOLIDATED
GENERAL PROCESS COMPLIANCE
SUPPLIER QUALITY SYSTEM CAPABILITY

FUNCTIONAL VIEW OF LIFE CYCLE
QUALITY FUNCTIONS -- DELEGATED
SPECIFIC PROCESS COMPLIANCE
PRODUCT DEVELOPMENT; SERVICE

12207 INVOKES 9001 FOR FURTHER QUALITY SYSTEM

TOPICS

1. BACKGROUND
2. BASIC CONCEPTS
3. THE PROCESSES
4. APPLICATION
5. RELATED AREAS
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SUMMARY

- **12207 IS THE TOP-LEVEL ARCHITECTURE OF SOFTWARE LIFE CYCLE**
  - Architecture built with processes
  - Processes have tasks and outcomes.

- **PROVIDES A COMMON FRAMEWORK FOR:**
  - Acquiring & supplying products & services
  - Managing & improving the processes
  - *World trade in software*

EPILOGUE

- **12207 IS NOT A SUBSTITUTE FOR DISCIPLINED MANAGEMENT AND ENGINEERING**

- **12207 PROVIDES MERELY THE BUILDING BLOCKS FOR CONSTRUCTING MODELS, STRATEGIES, AND PLANS FOR PROJECTS AND ORGANIZATIONS**
  - You need to proceduralize and automate the building blocks using your organizational knowledge and experience for that extra quality, competitiveness, and success

- **12207 SHOULD BE USED BY TRAINED PERSONNEL**

- **PLEASE READ THE STANDARD IN YOUR SPECIFIC CONTEXT: LEARNING, PROJECT, ORGANIZATION, ...**
  - Otherwise, it may be misinterpreted

TOPICS

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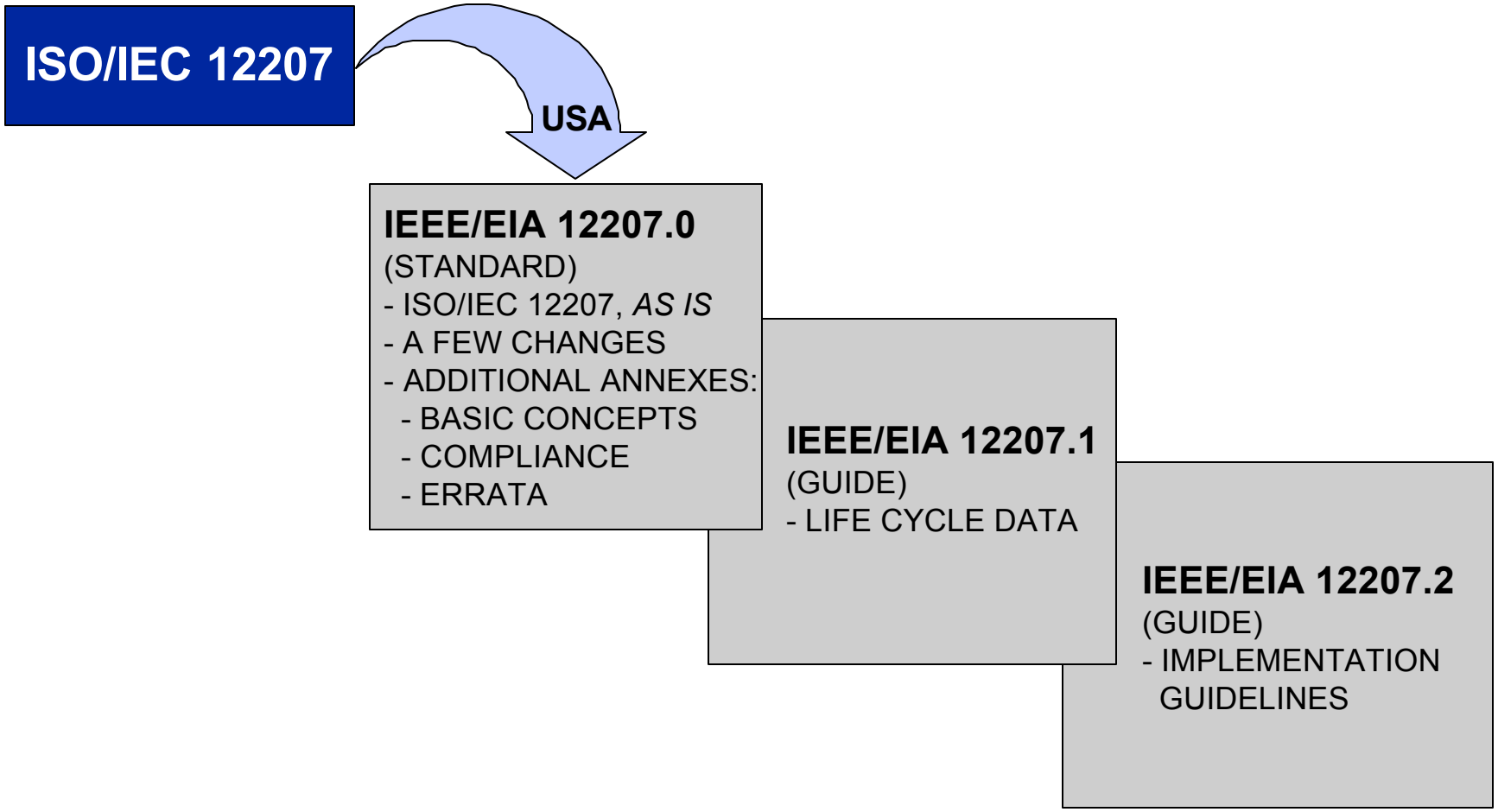
COST AND BENEFIT OF USING 12207

- **ASSUMPTION:** Basic software engineering environment instituted
- **COST/TIME OF IMPLEMENTING 12207 IN ORGANIZATION**
  - Unknown, but one-time cost
  - Factors:
    - Size/extent of software engineering environment
    - Size/diversity of the organization
- **COST OF 12207 TO A PROJECT**
  - Unknown, but savings through maintenance significant
  - Project-to-project cost should be lower
  - Factors:
    - Size/complexity of the project
    - Size of the personnel
    - Schedule and quality
    - Maturity levels of the acquirer and supplier
- **BENEFITS:**
  - The discipline
  - Reduced risk to cost, schedule and performance

ADAPTATION OF 12207 IN COUNTRIES

- **Most participating countries have issued their National versions**
- **The USA developed its version in 3 parts -- under ANSI's sponsorship:**



COPIES OF 12207

- **ISO:**
  1, rue de Varembe
  CH-1211 Geneve 20
  Switzerland (Suisse)

- **IEC:**
  3, rue de Varembe
  CH-1211 Geneve 20
  Switzerland (Suisse)

- **ANSI:**
  American National Standards Institute
  Customer Services
  11 West 42nd St,
  New York, NY 10036
  USA
  [Tel: +1 212 642 4900; Fax: +1 212 302 1286]

ISO/IEC 15288

System Life Cycle Processes

- **BACKGROUND:**
  - Jun 94: SC7 study group on software-system relationship
  - Feb 95: Study group report to SC7 (Doc # SC7 N1331)
  - Mar 95: US ANSI New Work Item proposal to SC7
  - Jun 95: SC7 acceptance of the proposal
  - Apr 96: JTC1 approval of the project
  - May 96: Work started
  - Dec 00: Completion

- **STUDY REPORT:**
  - The software-system relationship is poor; needs immediate attention
  - Software is always part of system
  - Hardware & software are inherently different
  - Hardware & software are marching almost separately
  - Hardware terms are often unrealistic in software
  - 12207 has limited effectiveness without a system context
  - Recommended a standard on life cycle processes for modern systems containing hardware, software, and humans

- **A CHALLENGE:**
  Analog, digital, and manual functions together!

THANK YOU
for
LISTENING

PLEASE PROVIDE COMMENTS/SUGGESTIONS TO:

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AIR-200, ROOM-815
800 INDEPENDENCE AVE, S.W.
WASHINGTON, DC 20591
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BACKUPS

COMING TO TERMS - I

- **ARCHITECTURE:**
  - The art and science of planning and building structures
  - A unifying or coherent form or structure
- **ASSESS:** Fix the value, size, importance of ...
- **AUDIT:** Check the authencity of ... against a baseline, especially officially
- **EVALUATE:** Determine the worth, amount, value, or condition of ...
- **COMPATIBILITY:** Usable together in harmony
- **COMPLY [with]**: follow/obey [rules/laws]
  - The builder's construction practices comply with the state's building code.
- **CONFORM [to]**: Be in accordance with [specs.]
  - The house conforms to the official specs. of the building code.
- **CONSISTENCY:** In agreement with; does not contradict.
- **CRITERION:** A "standard" on which judgment is based
- **DESIGN:**
  - The arrangement of elements or details in a product or work
  - An underlying schema that governs functioning, developing, or unfolding
- **ENVIRONMENT: A**n organization of manual and automated methods, techniques, and tools and personnel employed to produce products and provide services.
- **EXAMINE:** Test by questioning.

COMING TO TERMS - II

- **FORM, FIT & FUNCTION (3F):**
  - Form: physical configuration (shape) for interchangeability and compatibility
  - Fit: I/O characteristics for interoperability
  - Function: performance characteristics for "capable of doing its job."

- **FRAMEWORK:**
  - A skeletal structure to hold or support something constructed or stretched over it
  - Work done in a frame.

- **INSPECT:** Check critically

- **PROTOTYPE:** A [primitive] model that exhibits essential operational features ...

- **REQUIREMENT:**
  - Something obligatory, demanded as a condition
  - Something needed

- **REVIEW:** A general survey of ...

- **SYSTEMATIC:** Definite scheme/method of procedure/classification

- **VALIDATE:**
  - Confirm the validity of ...
  - Declare legally valid

- **VERIFY:**
  - Check the correctness of ... by comparison
  - Prove to be true.

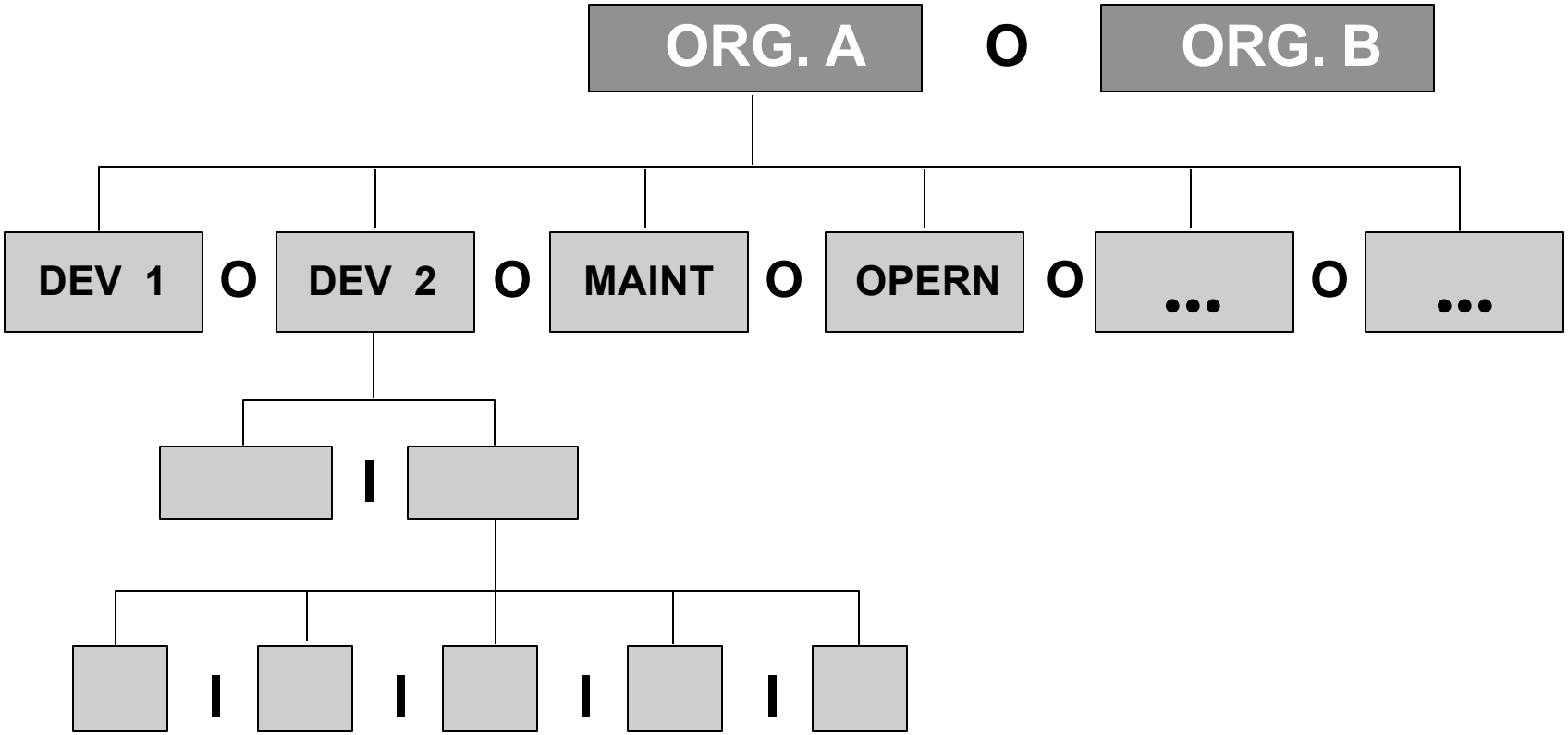
INDEPENDENCE & ORGANIZATIONAL FREEDOM

I: INDEPENDENCE:

- FROM THOSE PERFORMING THE TASK OR DEVELOPING THE PRODUCT

O: ORGANIZATIONAL FREEDOM:

- FROM THOSE WHO HAVE MANAGEMENT RESPONSIBILITY FOR THE TASK/PRODUCT



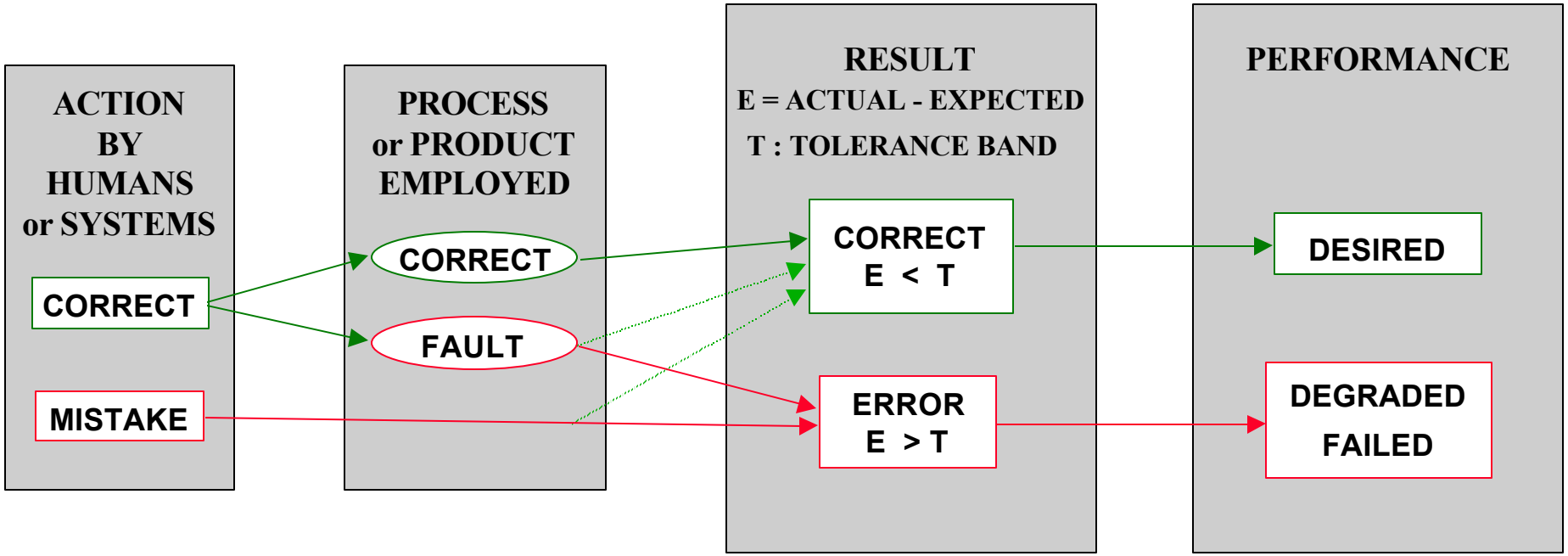
"FAULTY" TERMS

Error: Difference between computed and observed

Fault: Incorrect step/process/data definition ...

Failure: Incorrect result

Mistake: Action that produces an incorrect result



Cause of Error (a result, a manifestation):

- Fault in the process or the product
- Mistake by the system or human

VERBAL FORMS - I

IEC/ISO Directive , Part 3, Edition 1989

"**4.1.2** A standard does not in itself impose any obligation upon anyone to follow it. However, such an obligation may be imposed, for example, by legislation or by a contract. In order to be able to claim compliance with a standard, the user needs to be able to identify the requirements he is obliged to satisfy. He needs also to be able to distinguish these requirements from other provisions where he has a certain freedom of choice.

Clear rules for the use of verbal forms (including modal auxiliaries) are therefore essential.

Annex C gives, in the first column of each table, the verbal form that shall be used to express each kind of provision. The equivalent expressions given in the second column shall be used only in exceptional cases when the form given in the first column cannot be used for linguistic reasons."

[See the next chart for specific verbs.]

VERBAL FORMS - II

Annex C, IEC/ISO Directive , Part 3, Edition 1989

REQUIREMENT

VERB	MEANING
shall	is to ...
	is required to
	has to ...
	only ... is permitted
	it is necessary ...
shall not	it is not allowed
	is required to be not
	is required that ... be not
	is not to be
must	used to describe unavoidable situations

RECOMMENDATION

VERB	MEANING
should	it is recommended that
	ought to
should not	it is recommended that ... not
	ought not to

PERMISSION

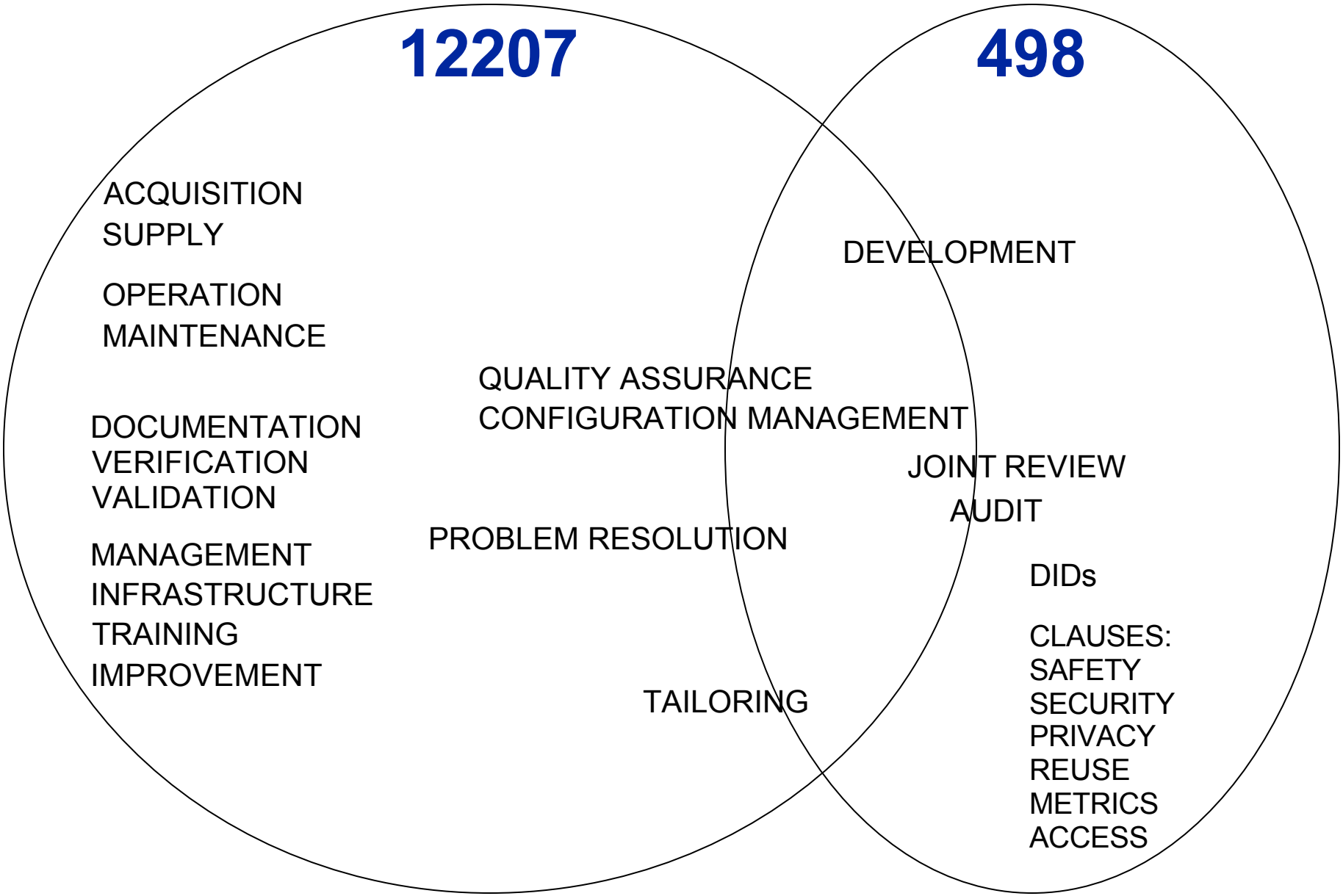
VERB	MEANING
may	is permitted
	is allowed
	is permissible
need not	it is not required that
	no ... is required

POSSIBILITY

VERB	MEANING
can	to be able to
	to be in a position to
	there is a possibility of
	it is possible to
cannot	to be unable to
	to be not in a position to
	there is no possibility of
	it is impossible to

- 12207 defines and uses “will,” which is not yet defined by ISO/IEC Directives.
- “Will” in 12207 means self-declaration and requirement.

12207 & MIL-STD-498



12207 & MIL-STD-498 DIDs

- 498 is a development & documentation standard from acquisition perspective.
- 498 is a family of standards, under DOD Directives and MIL-STD-499B (Systems).
- 12207 addresses the life cycle and stakeholders.

12207 DEVELOPMENT DOCUMENTATION	DIDs of MIL-STD-498
Acquisition process (5.1.1.1, 5.1.1.8)	OCD; PMP (Gov't)
Supply process (5.2.4.5)	SDP; CM; QA; [SEMP/499B]
Plans for the dev. [versions in CM] (5.3.1.4)	SDP [Includes CM, QA, ...]; SVD
System requirements specification (5.3.2.1)	SSS
System architecture (5.3.3.1)	SSDD
Software requirements/specs. (5.3.4.1)	SRS; IRS
Architecture of software item (5.3.5.1)	SDD; SPS
Detailed design (5.3.6.1)	SDD; IDD; SPS
Database design (5.3.6.3)	DBDD
Software units and databases (5.3.7.1)	SPS; DBDD
Test reqs. (5.3.5.5, 5.3.6.5, 5.3.7.4, 5.3.8.1)	STP; STD; STR
Installation plan (5.3.12.1)	SIP
,,	STrP (Transition)
User's manuals(5.3.5.4, ..., 5.3.9.2)	SUM; SIOM; SCOM; COM; CPM; FSM
Evaluation records (5.3.2.2, ..., 5.3.11.2)	Internal records

12207: USING IT IN YOUR ORGANIZATION

- Tailor at two levels:

  1. Adaptation at organization level
     - Environment with methods, tools & techniques
  2. Tailoring the “adaptation” for each project

- Involve potential contractors and the post-development personnel

- Avoid fixed-price contract for software

12207: ADAPTATION TIPS

- **ADAPT ISO/IEC 12207**
  - Begin with IEEE/EIA 12207 -- or NATO AQAP 150
  - Incorporate changes and additions for your business sector
  - Institutionalize the Acquisition process (12207/5.1)
    - Ensure all tasks are supportable with personnel and procedures

- **INVOKE SPECIALTY "STANDARDS"**
  - Invoke RTCA DO-178B for the software requirements that impact system safety.
  - Similarly for security and human factors

- **DEVELOP "DOCUMENTATION STANDARDS":**
  - Similar to US DoD's DIDs
    - Demilitarize (use Jt-Std 016's)
    - No prescription on format, media, etc.
  - To manage software development
  - For post-development personnel (operations, maintenance, et. al.)

12207: TAILORING TIPS

- **DEVELOP YOUR OWN TAILORING GUIDANCE:**

  - Similar to MIL-HDBK-287 (Tailoring guide for 2167A)
  - Base on tailoring criteria in 12207's Annexes A and B
  - Automate tailoring like *2167A Tailor*

  - Use a combination of the following:
    - The contractor has implemented a 12207 environment:
      - Develop guidance on assessing the environment
    - 12207 is directly used in contract:
      - Develop tailoring guidance for types of projects

  - Do not compromise your project for off-the-shelf software
    - Ensure clause 5.1.1.7 is FULLY satisfied

  - Aviod non-developmental item trap; Address clause 5.3.1.5.

  - Consider evolutionary models -- with baselines and builds

WHAT IS A STANDARD?

- **A COMMON PRODUCT**
  - Identified as a preferred item in a situation

- **A WRITTEN SET OF REQUIREMENTS FOR PRODUCTS (3F):**
  - Form:
    - Physical configuration for interchangeability/compatibility
  - Fit:
    - Dimensional description of i/o for interoperability
  - Function:
    - Performance characteristics for job

- **AN ACCEPTED PROCESS OR PROCEDURE**
  - A series of actions or operations

- **EXCEPTIONS:**
  - Natural phenomena
  - Laws or regulations mandated by governments
    - Health, environment, safety, security, ...

CONFORMITY & CERTIFICATION
SOFTWARE PRODUCT & PROCESS

	STANDARDIZATION	ADAPTATION TAILORING	CONFORMANCE COMPLIANCE	CERTIFICATION
PRODUCT	3F specs.	Applicable 3F specs.	Meets the applicable 3F specs.	Meets the applicable 3F specs.
PROCESS	Activities/tasks for the services in the life cycle	Applicable activities & tasks	Satisfies the applicable activities & tasks	? - Activities/tasks performed as planned ? - Provides the products/services as specified

3F: Form, Fit, Function

CONFORMITY SHOULD BE ADDRESSED SEPARATELY FOR PRODUCTS AND PROCESSES
-- SO SHOULD BE CERTIFICATION

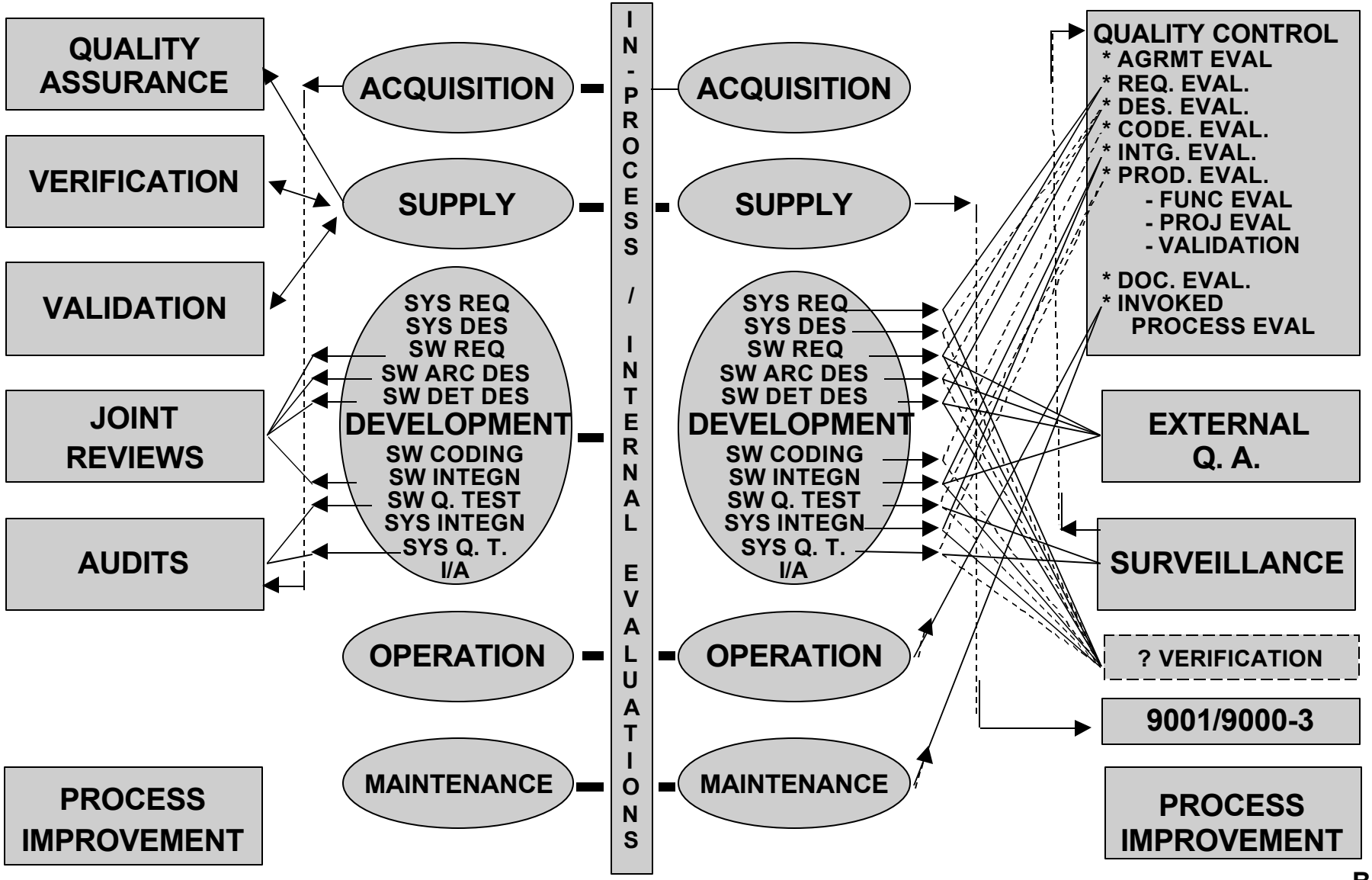
QUALITY MODELS

DELEGATED/SHARED QUALITY

[12207]

MONOLITHIC QUALITY

[DRAFT OF 12 FEB 93]



HUMOR IN CODE

Once God decided to find out what the Earthlings were up to. S/he descends upon the Earth. Finds a little girl crying over a broken doll, fixes it, and consoles her. Moves on. So s/he helps other people.

Just before departing, God sees a haggard man brooding over a piece of paper. S/he asked who he was and what was the problem. The man said he was a programmer, but asked whether s/he had any programming experience. S/he humbly admitted to have programmed things from Big Bangs to Black Holes. Impressed, the man showed his paper.

God reviewed the paper and, after a pause, said, "Son, I think this one is *yours*."

Anonymous

POWED!

Q. How to have a standard powed?
A. Utter one of the following:

- **<u>P</u>rescriptive**
  "It's prescriptive."
- **<u>O</u>OD (and Ada)**
  "I can't use OOD (and Ada) with it."
- **<u>W</u>aterfall**
  "It's a Waterfall model."
- **<u>E</u>xpensive**
  "It's expensive to use."
- **<u>D</u>ocumentation**
  "It's documentation dependent."