Overview of Maintenance

CPRE 416-Software Evolution and Maintenance-Lecture 3

Need to Study Software Maintenance

Software Maintenance is the single most expensive activity in software engineering requiring 65% to 70% of total effort.

– Software Engineering by Somerville

Journal of Software Maintenance

In 1989, a new Journal dedicated to software maintenance was launched by John Wiley. The *Journal of Software Maintenance: Research and Practice* appears quarterly, and it publishes refereed papers on topics in software maintenance that are of interest to both practitioners and academics.

http://www.dur.ac.uk/CSM/JSM/

Centre for Software Maintenance

The Research Institute for Software Evolution (RISE) formerly the Centre for Software Maintenance (CSM) was established in April 1987, at the University of Durham, England. It is the first such centre world-wide to concentrate its research on software evolution.

http://www.dur.ac.uk/CSM/

International Conference on Software Maintenance

2004 Chicago Illinois, USA **Celebra**

http://www.cs.iit.edu/~icsm2004/

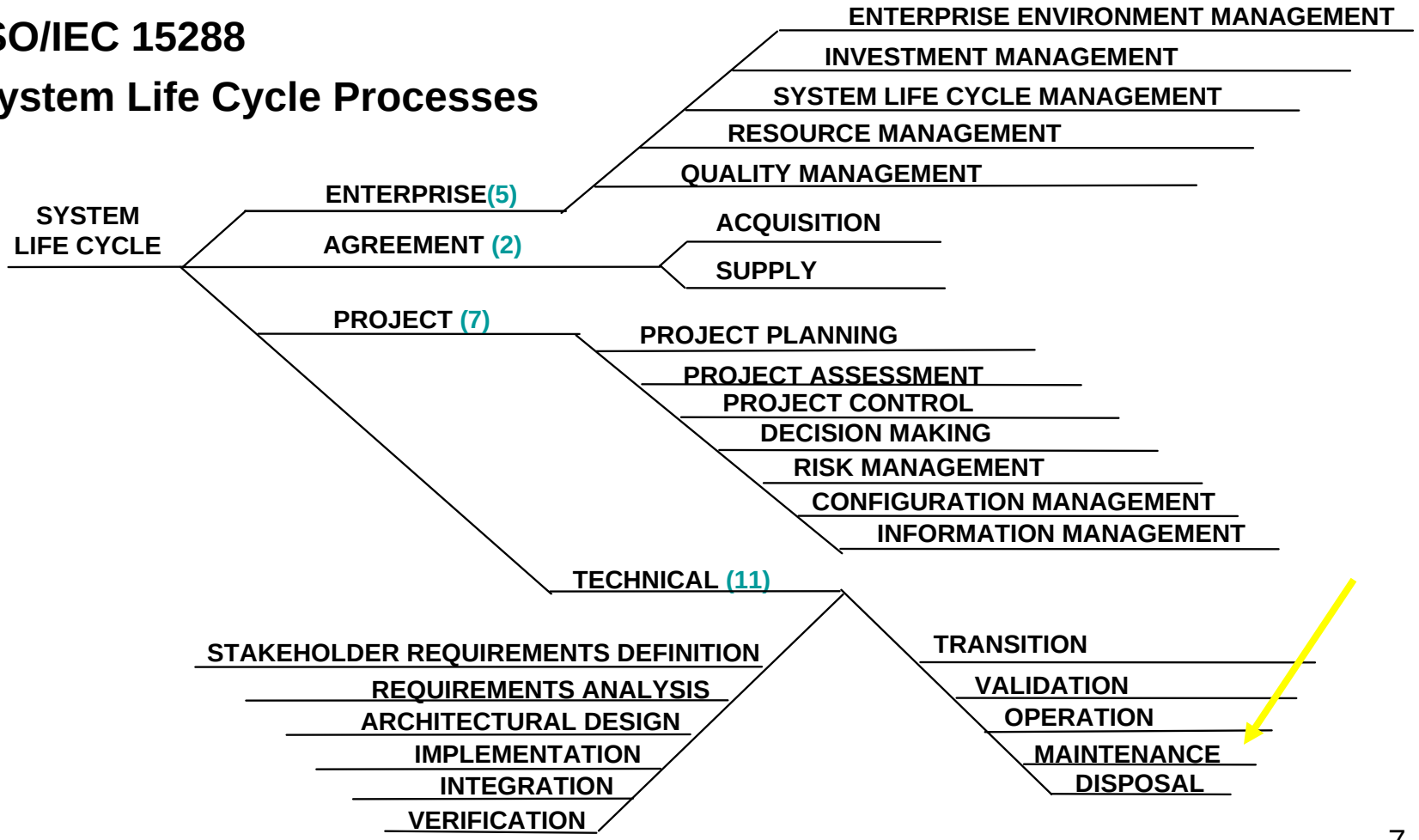
Types of Maintenance Activities

- Preventive Maintenance
  - Identify and detect latent faults
  - Systems with safety concerns
- Corrective Maintenance
  - Identify and remove defects
  - Correct actual errors
- Emergency Maintenance
  - Unscheduled corrective maintenance
- Perfective Maintenance
  - Improve performance, dependability, maintainability
  - Update documentation
- Adaptive Maintenance
  - Adapt to a new/upgraded environment (e.g., hardware, operating system, middleware)
  - Incorporate new capability

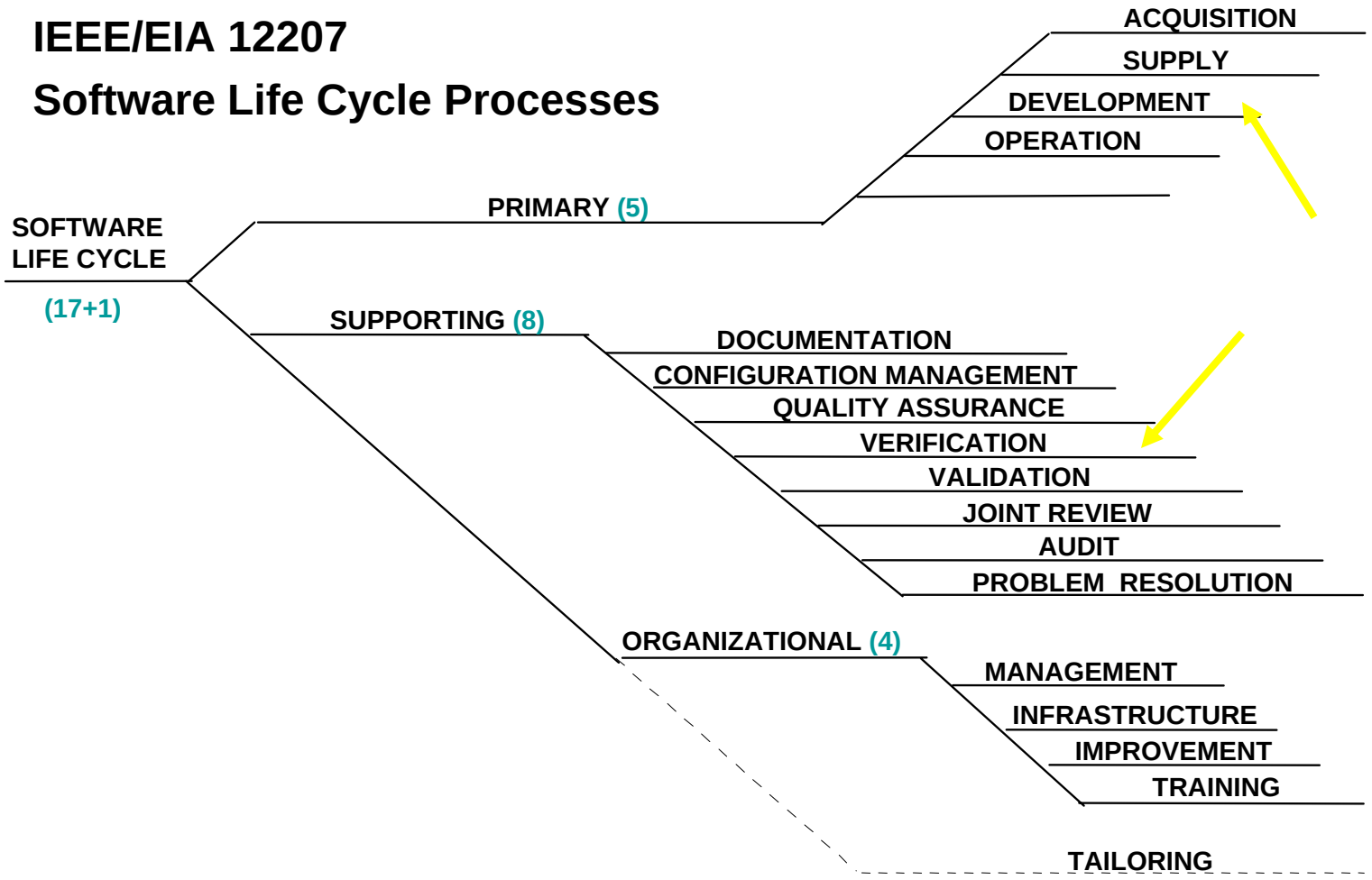
Maintenance in the System Life Cycle

ISO/IEC 15288

System Life Cycle Processes



Maintenance in the Software Life Cycle



How does the CMMI® Treat Maintenance?

- Development
  - The word “development,” when used in the CMMI Product Suite, implies not only development activities, but also *maintenance* activities.
  - Projects that benefit from the best practices of CMMI can focus on *maintenance*, development, or both.
- The term *Maintenance* appears in the CMMI 70 times.

Source: CMMI® -SE/SW/IPPD/SS, V1.1, Continuous Representation, © CMU SEI,2002.

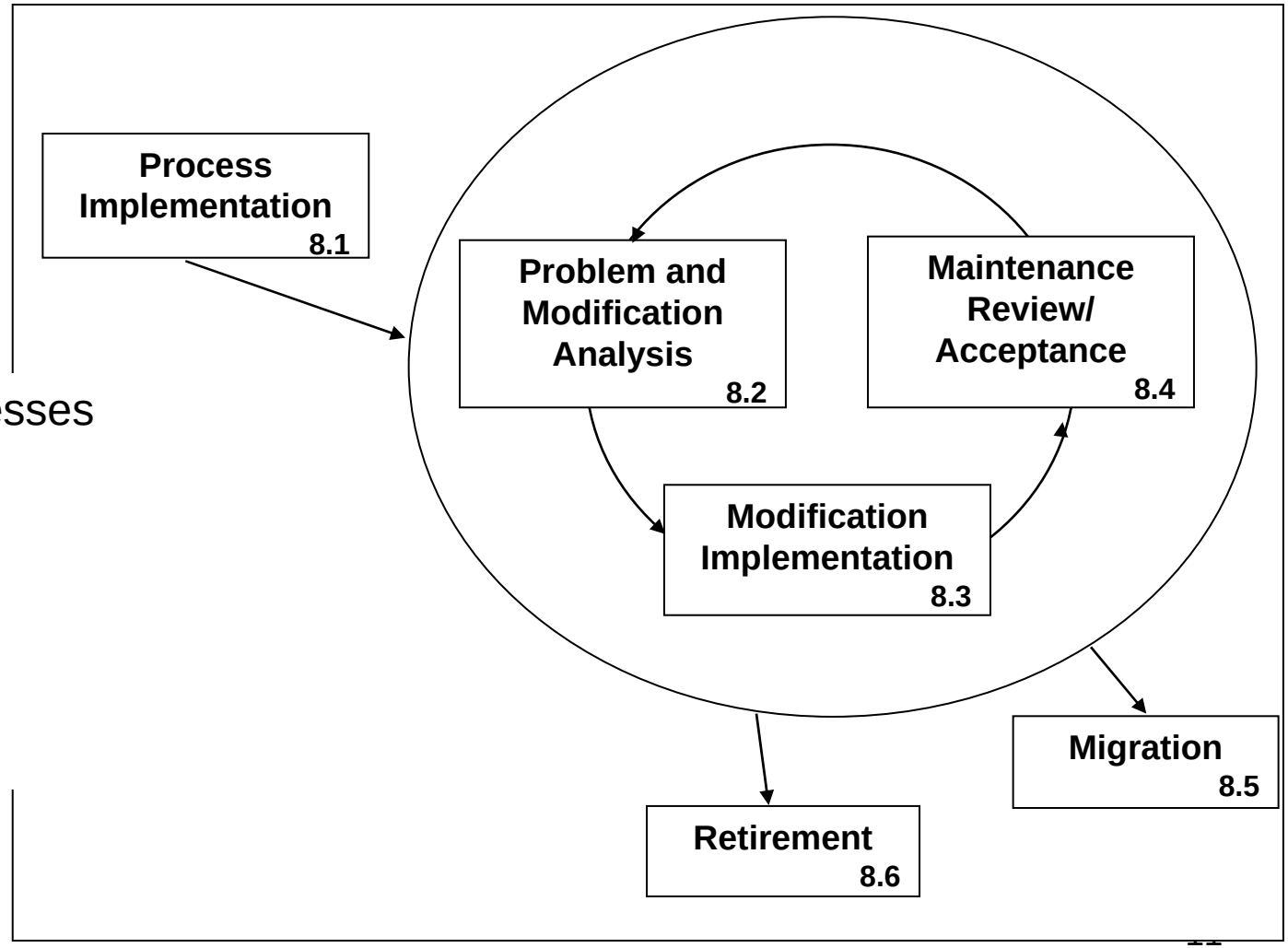
The CMMI® and Software Maintenance – Objectives

IEEE/EIA 12207 Maintenance Objectives	CMMI® **Processes**
Define the impact of organization, operations, and interfaces on the existing system in operation	TS, RSKM
Identify and update life cycle data	RD, REQM, RSKM
Develop modified system components with associated documentation and tests that demonstrate that the system requirements are not compromised	TS, PI, VER, VAL, CM, PPQA, RSKM
Migrate system and software upgrades to the user's environment	PI, CM, PPQA
Ensure fielding of new systems or versions does not adversely affect ongoing operations	VER, VAL, RSKM
Maintain the capability to resume processing with prior versions	TS, CM

ISO/IEC 14764 – Maintenance Processes

Clause number

Maintenance Processes
- Input
- Task
- Controls
- Support
- Outputs



Source:
ISO/IEC 14764:1999,
© ISO/IEC1999.

IEEE 1219 – Maintenance Processes

- Problem/modification identification, classification, and prioritization
- Analysis
- Design
- Implementation
- Regression/system testing
- Acceptance testing
- Delivery

Source: IEEE 1219-1998, © IEEE, 1998. : clauses 4.1 to 4.7

NASA Case Study

- Reported in a paper http://www.cs.umd.edu/projects/SoftEng/ESEG/papers/ICSE96.html
- Goal: understand and estimate the cost of maintenance releases of software systems.
- Conducted in the Flight Dynamics Division (FDD) of NASA Goddard Space Flight Center (GSFC).
- A quantitative analysis of the data collected from January 1994 to June 1995 on the delivery process of over 29 releases of 11 different systems.

Background

- GSFC manages and controls NASA's Earth-orbiting scientific satellites and also supports Space Shuttle flights.
- Maintains over 100 different software systems, ranging in size from 10 thousand source lines of code (KSLOC) to 250 KSLOC, and totaling approximately 4.5 million SLOC.
- 85% are written in FORTRAN, 10% in Ada, and 5% in other languages. Most of the systems run on IBM mainframe computers, but 10% run on PCs or UNIX workstations.

Maintenance Activities

- Impact analysis/cost benefit analysis.
- Isolation.
- Change design.
- Code/unit test.
- Inspection/certification/consulting
- Integration test.
- Acceptance test.
- Regression test.
- System documentation.
- User/other documentation.

Outcomes of the Study

- A predictive effort model for the FDD's software maintenance release process.
- Measurement-based lessons learned about the maintenance process in the FDD.

Homework

- Submit hard type-written copies at the beginning of the class on Friday, September 2. Out of 10 points, two points will be for quality of presentation.
- Questions are posted on the web.