AALBORG UNIVERSITY

Management and MDD

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E2-201
Information Systems
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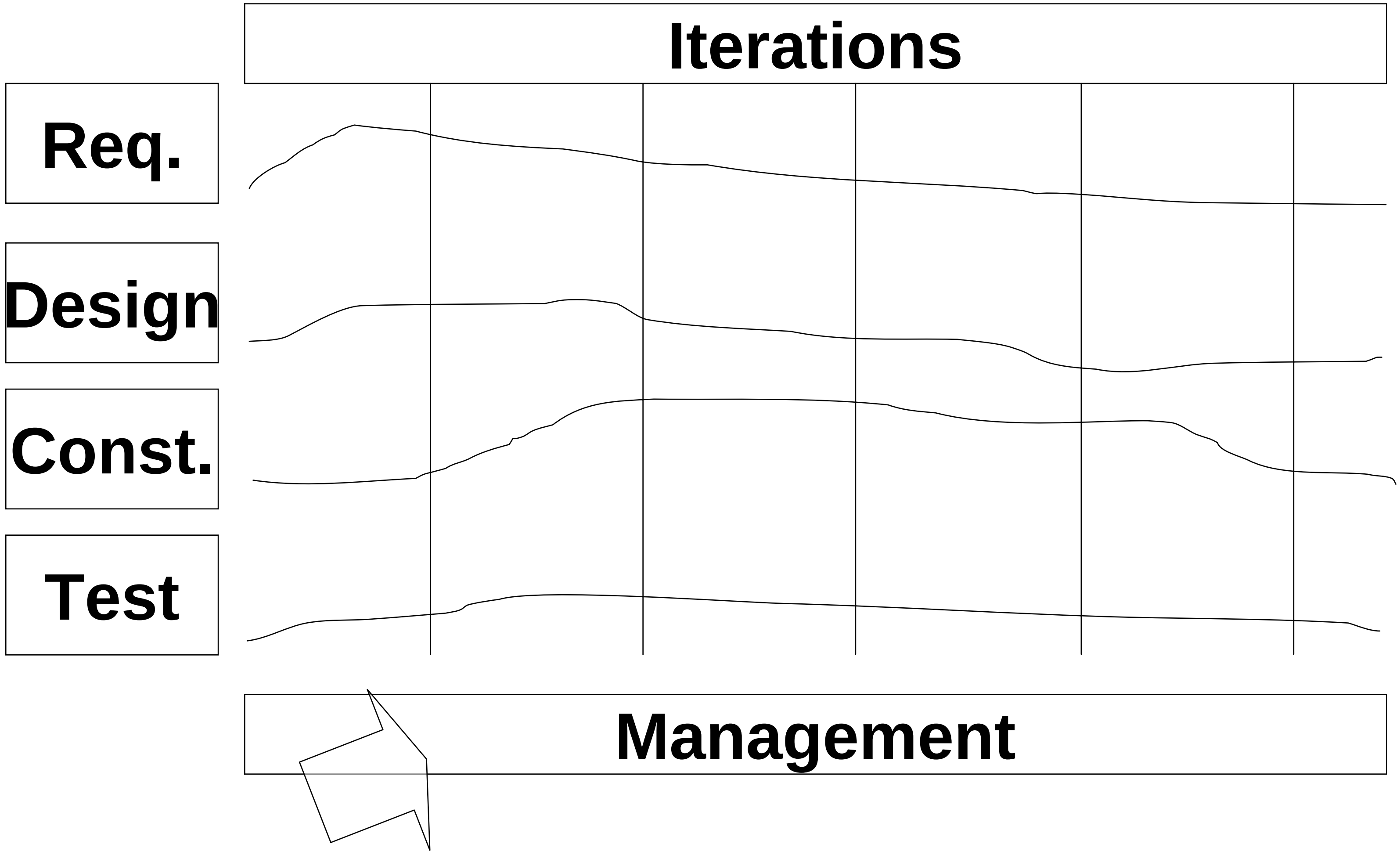
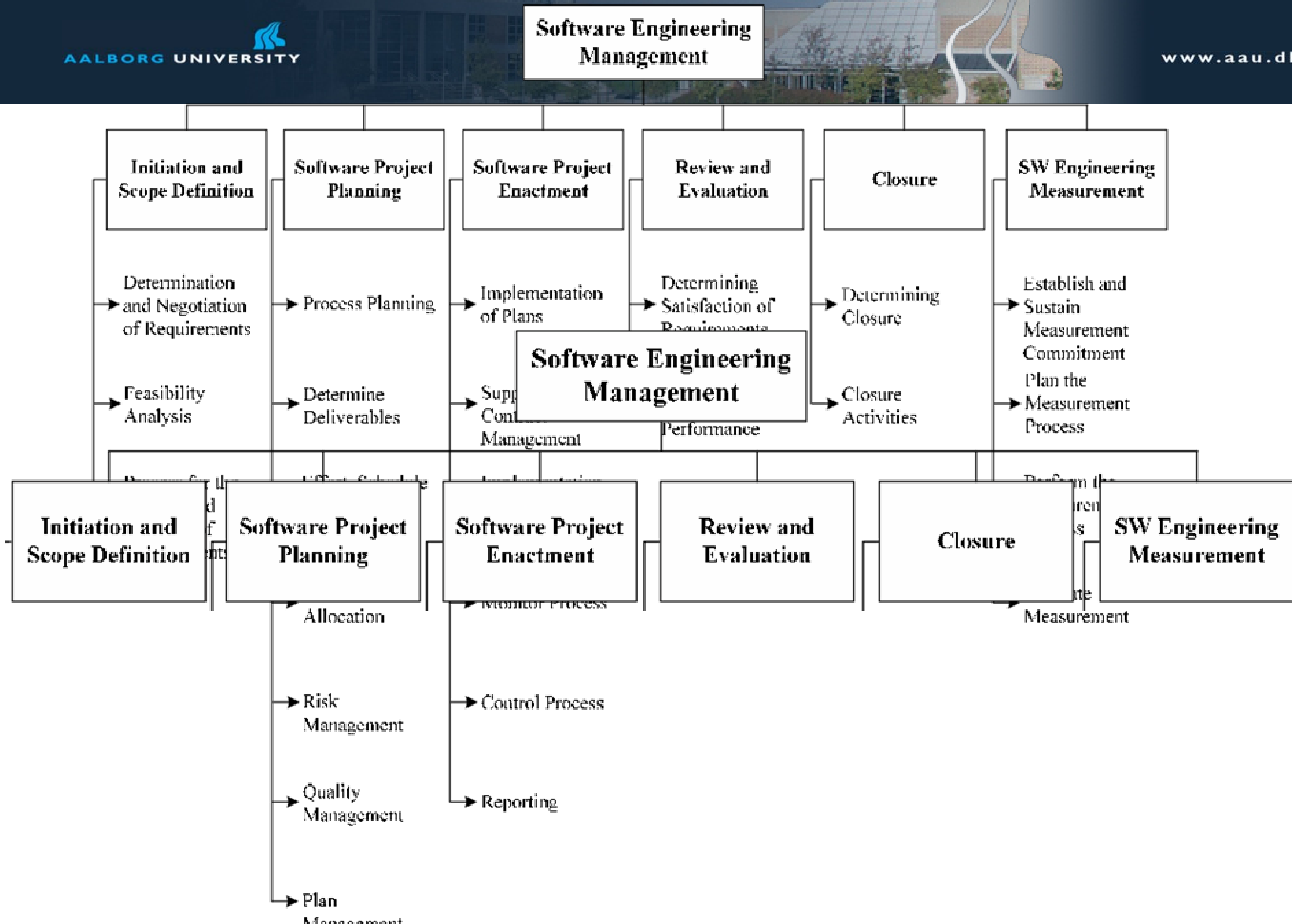
Management

Software Engineering Management


Iterations
Req.
Design
Const.
Test
Management


Software Engineering Management
Initiation and Scope Definition
Software Project Planning
Software Project Enactment
Review and Evaluation
Closure
SW Engineering Measurement
Determination and Negotiation of Requirements
Feasibility Analysis
Process Planning
Determine Deliverables
Allocation
Risk Management
Quality Management
Plan Management
Implementation of Plans
Control Process
Reporting
Determining Satisfaction of Requirements
Performance
Determining Closure
Closure Activities
Establish and Sustain Measurement Commitment
Plan the Measurement Process
Measurement
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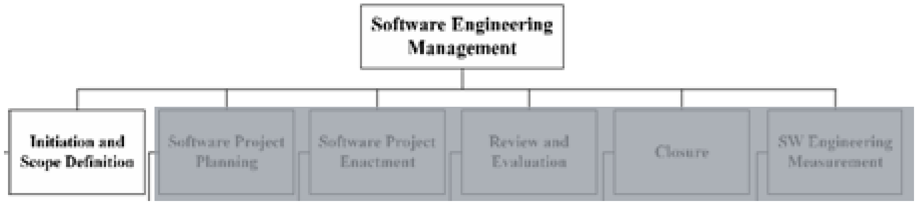
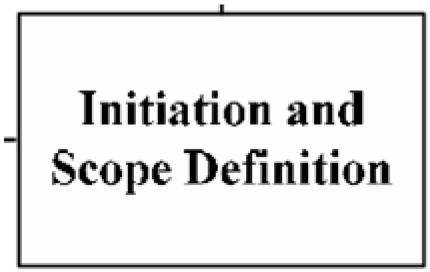
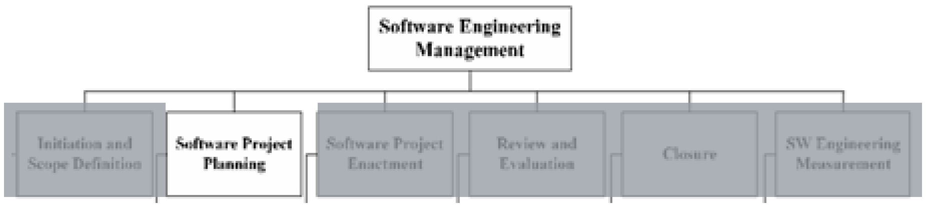
SW Engineering Measurement

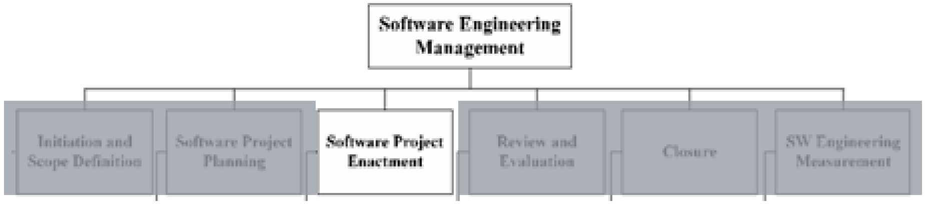




- Determination and Negotiation of Requirements
- Feasibility Analysis
- Process for the Review and Revision of Requirements

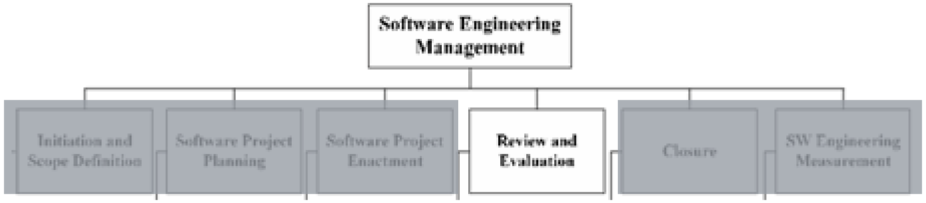


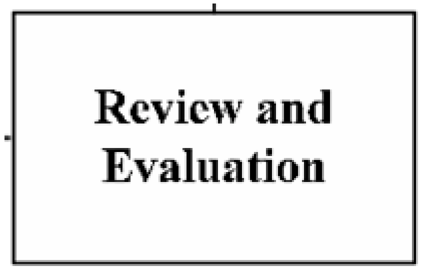
- Process Planning
- Determine Deliverables
- Effort, Schedule and Cost Estimation
- Resource Allocation
- Risk Management
- Quality Management
- Plan Management



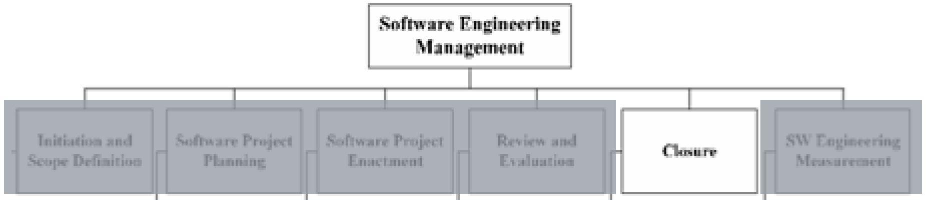
Software Project Enactment

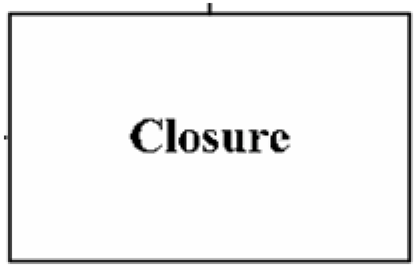
- Implementation of Plans
- Supplier Contract Management
- Implementation of Measurement Process
- Monitor Process
- Control Process
- Reporting



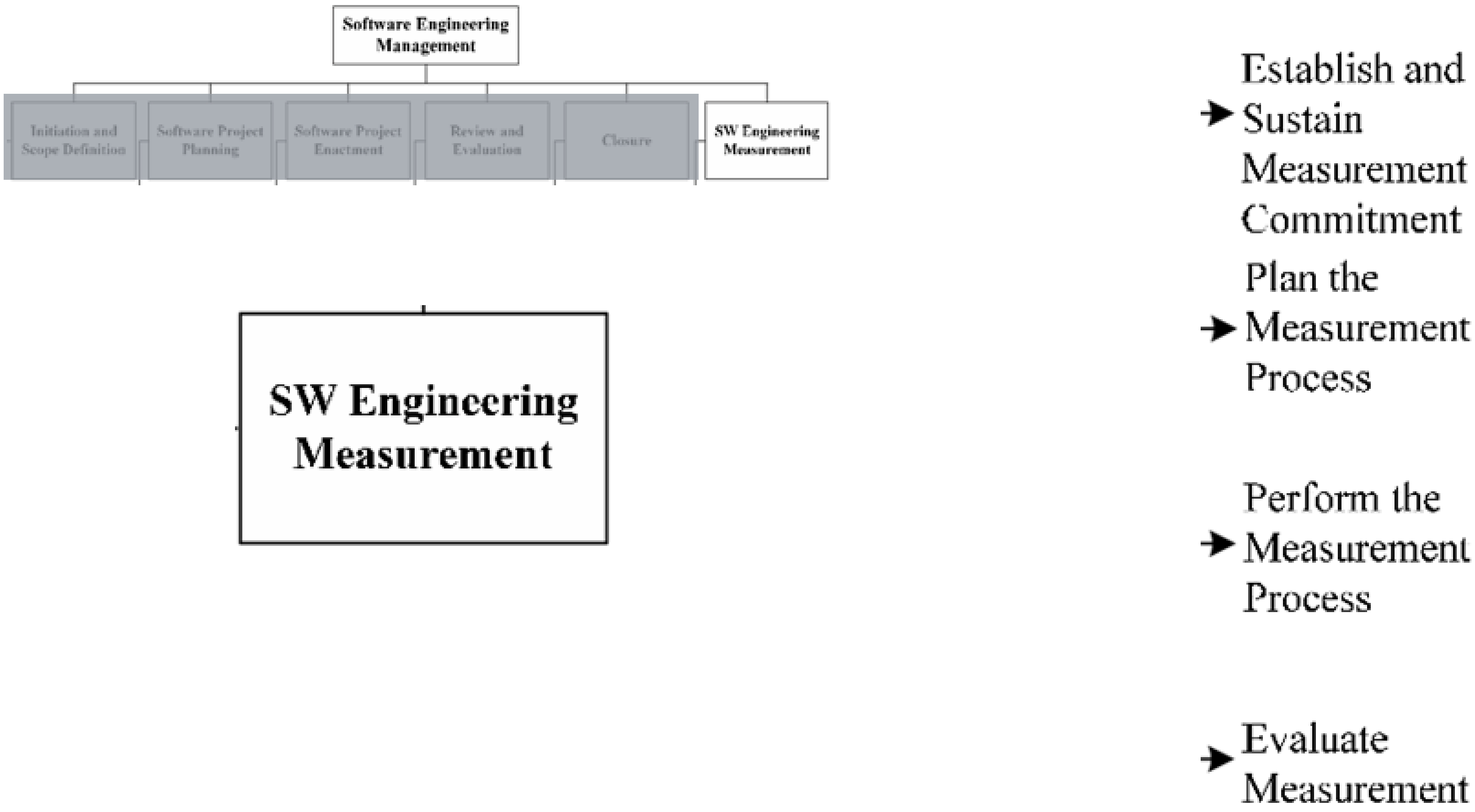


- Determining Satisfaction of Requirements
- Reviewing and Evaluating Performance





- Determining Closure
- Closure Activities


Software Engineering Management
Initiation and Scope Definition
Software Project Planning
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Review and Evaluation
Closure
SW Engineering Measurement
SW Engineering Measurement
Establish and Sustain Measurement Commitment
Plan the Measurement Process
Perform the Measurement Process
Evaluate Measurement

Determination of software scope

Function
Performance
Constraints
Interfaces, and
Reliability

Understand the customers needs

Understand the business context

Understand the project boundaries

Understand the customer’s motivation

Understand the likely paths for change

The Purpose of Planning

Reduce uncertainty of the future.

- All estimates are wrong, but any estimate is better than no idea at all.

To ensure that resources are being used as profitably as possible at all times.

To provide an objective measure of how well a project is progressing.

- If we have made an estimate it will be clear if we have not achieved it.

The Steps

Scoping—understand the problem and the work that must be done

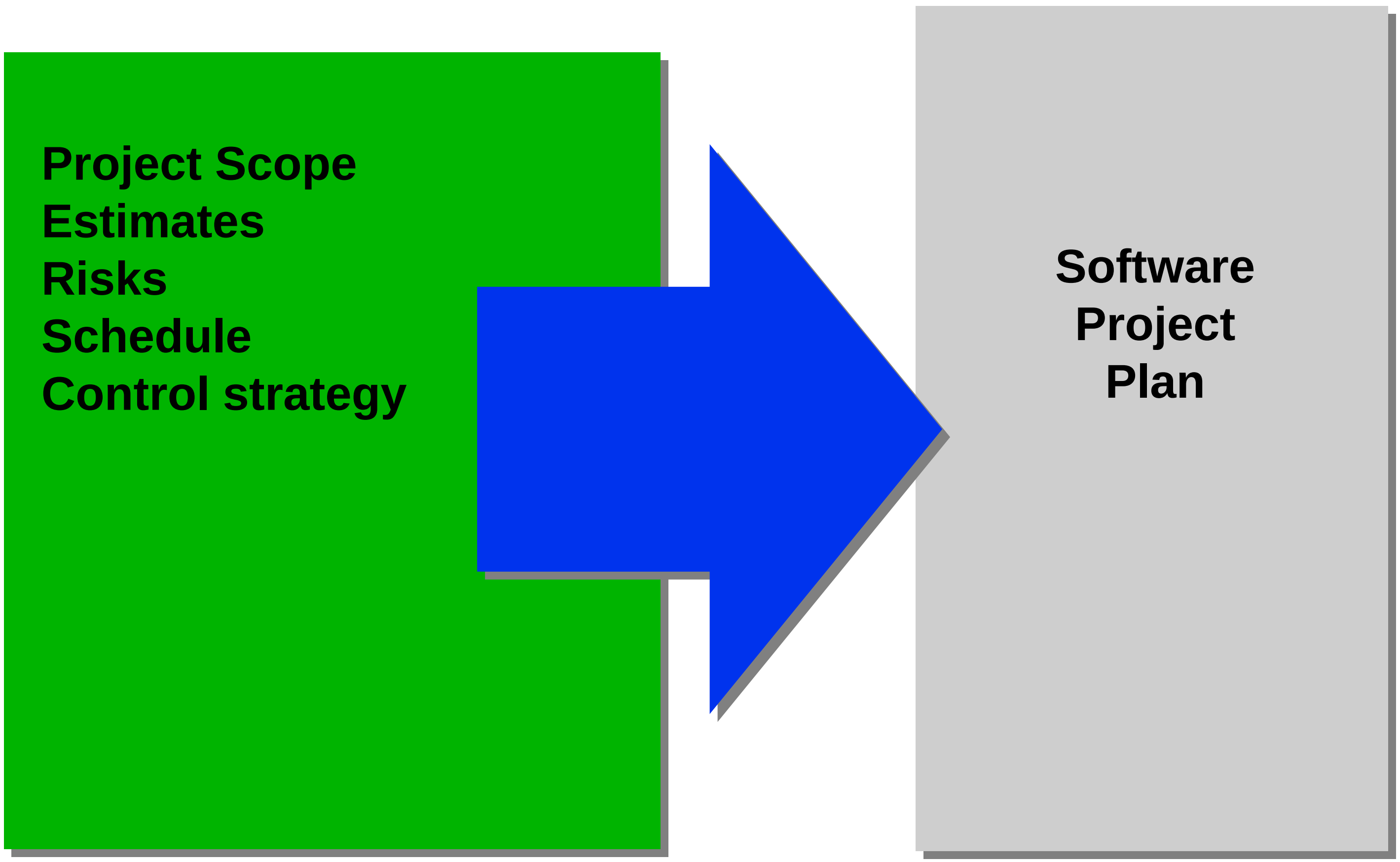
Estimation—how much effort? how much time?

Risk—what can go wrong? how can we avoid it? what can we do about it?

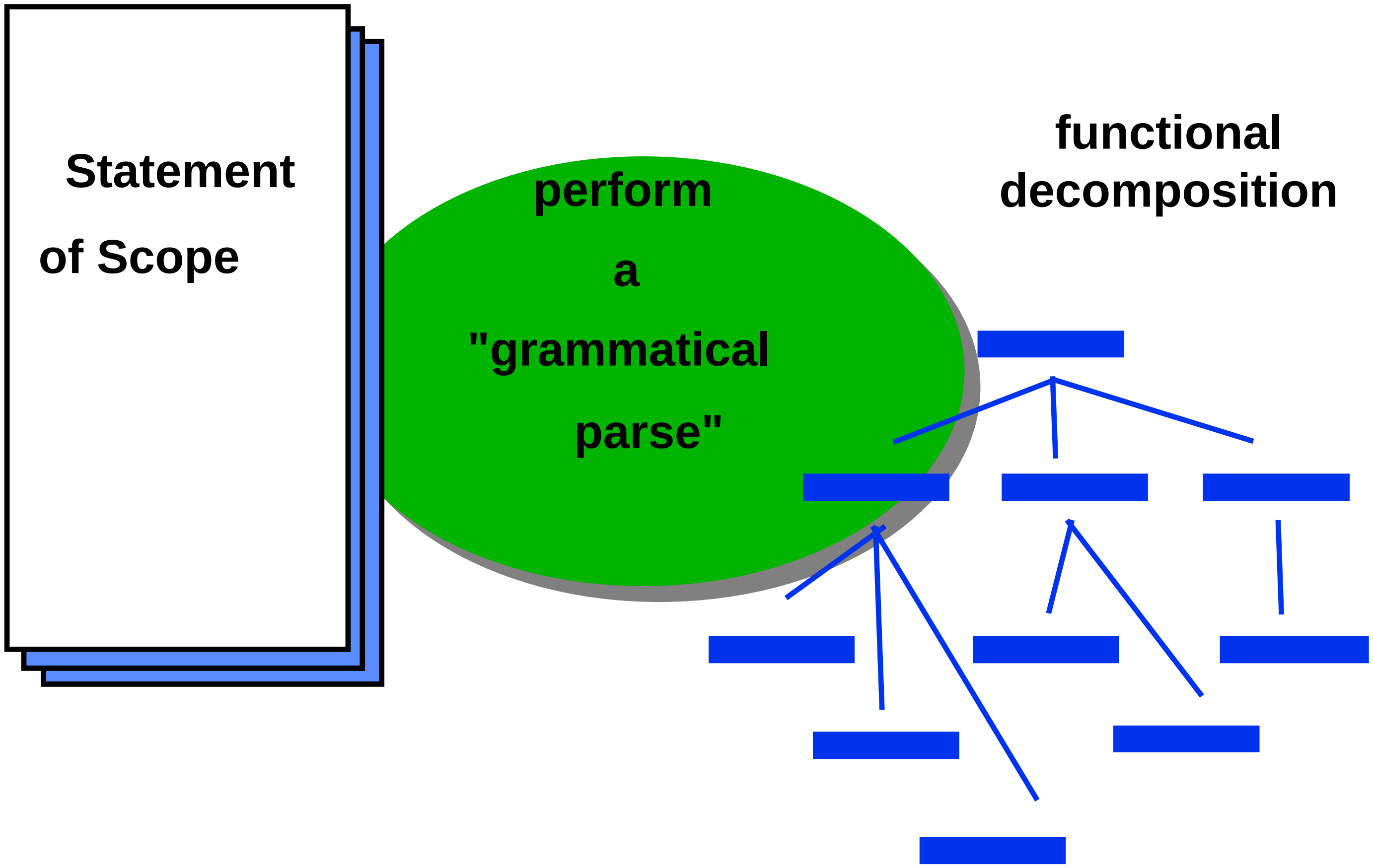
Schedule—how do we allocate resources along the timeline? what are the milestones?

Control strategy—how do we control quality? how do we control change?

Write it Down!



Functional Decomposition



Estimation of resources

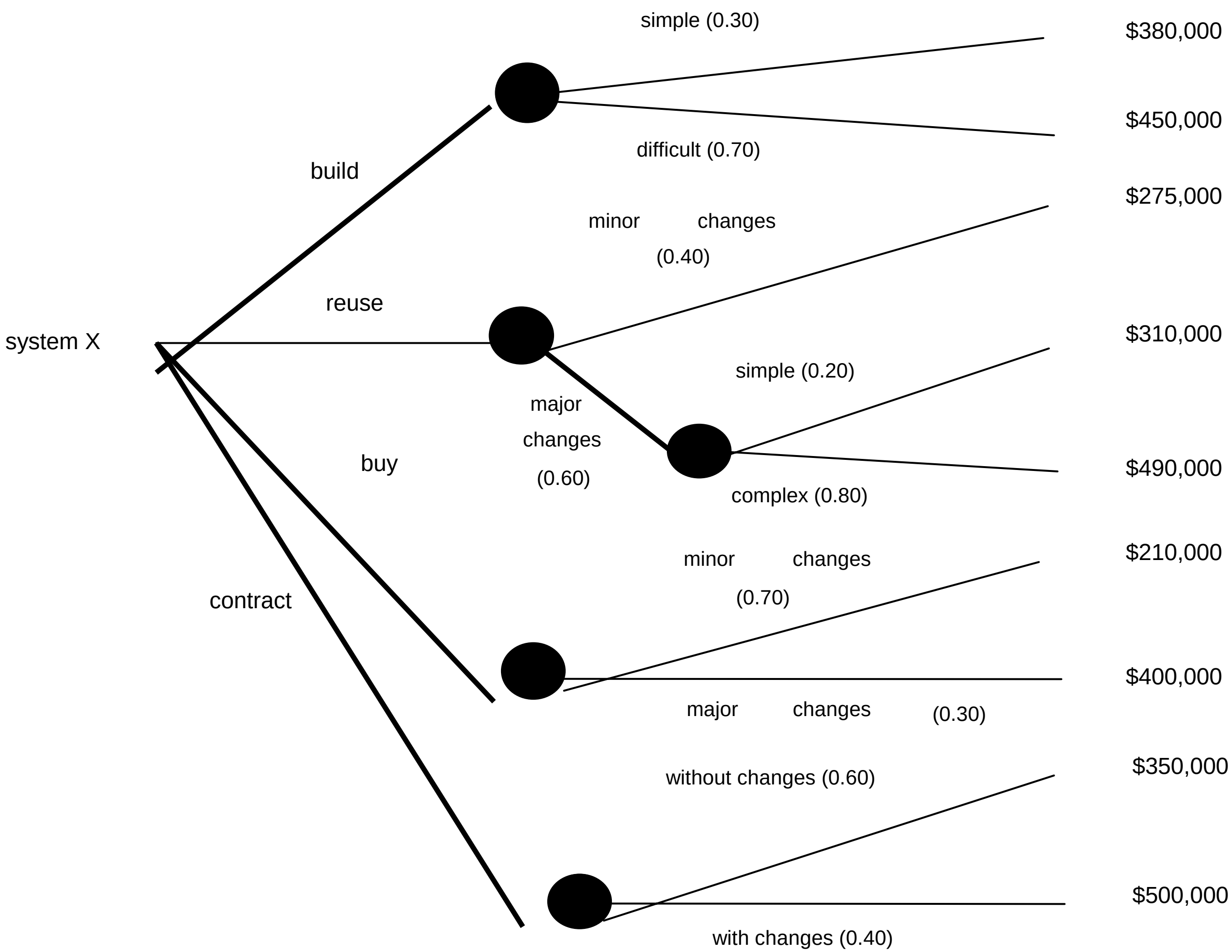
People

Reusable Software Components

- Off-the-shelf components
- Full-experience components
- Partial-experience components
- New components

Environment (Hardware/Software Tools)

The Make-Buy Decision



Computing Expected Cost

expected cost =

$$\sum (\text{path probability})_i \times (\text{estimated path cost})_i$$

For example, the expected cost to build is:

$\text{expected cost}_{build} = 0.30(\$380K)+0.70(\$450K) = \$429\ K$

Similarly,

$\text{expected cost}_{reuse} = \$382K$

$\text{expected cost}_{buy} = \$267K$

$\text{expected cost}_{contr} = \$410K$

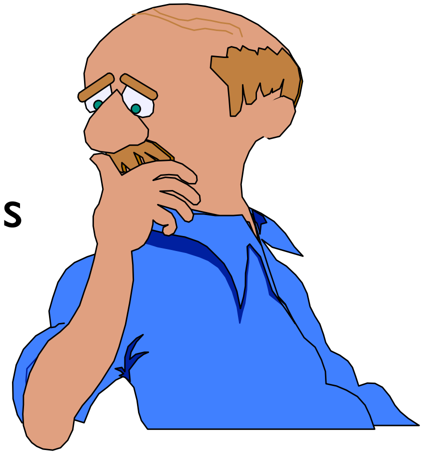
Estimation Techniques

Past (similar) project experience

Conventional estimation techniques

- Task breakdown and effort estimates
- Size (e.g., FP) estimates

Tools



Estimation: Implicit Techniques

Characteristics:

- Based on implicit relation of experience, knowledge, expectations and estimate
- Mainly based on tacit knowledge

Typical examples:

- Expert-judgement
- Wideband Delphi

Estimation: Explicit Techniques

Decomposition techniques:

- Software sizing
  - “Fuzzy-logic” sizing
  - Function point sizing
  - Standard component sizing
  - Change sizing

Estimation: Explicit Techniques

Decomposition techniques:

- Problem-based estimation
  - Estimate size by functional decomposition
  - Combine the size estimate with historical data relating size with effort and costs

Process-Based Estimation

Bases its estimate on the process that will be used

- The process is decomposed into a relatively small set of activities or tasks
- Problem functions and process activities are melded, then the planner estimates the effort that will be required to accomplish each software process activity for each software function
- Finally, costs and effort for each function and software process activity are computed

Problem-based Example: LOC

Functions	estimated LOC	LOC/pm	$/LOC	Cost	Effort (months)
UICF	2340	315	14	32,000	7.4
2DGA	5380	220	20	107,000	24.4
3DGA	6800	220	20	136,000	30.9
DSM	3350	240	18	60,000	13.9
CGDF	4950	200	22	109,000	24.7
PCF	2140	140	28	60,000	15.2
DAM	8400	300	18	151,000	28.0
Totals	33,360			655,000	145.0

Problem-based Example : FP

measurement parameter	count		weight		
number of user inputs	40	x	4	=	160
number of user outputs	25	x	5	=	125
number of user inquiries	12	x	4	=	48
number of files	4	x	7	=	28
number of ext.interfaces	4	x	7	=	28
algorithms	60	x	3	=	180
count-total →					569
complexity multiplier					.84
feature points →					478

feature points 478 × 0.25 p-m / FP = 120 p-m

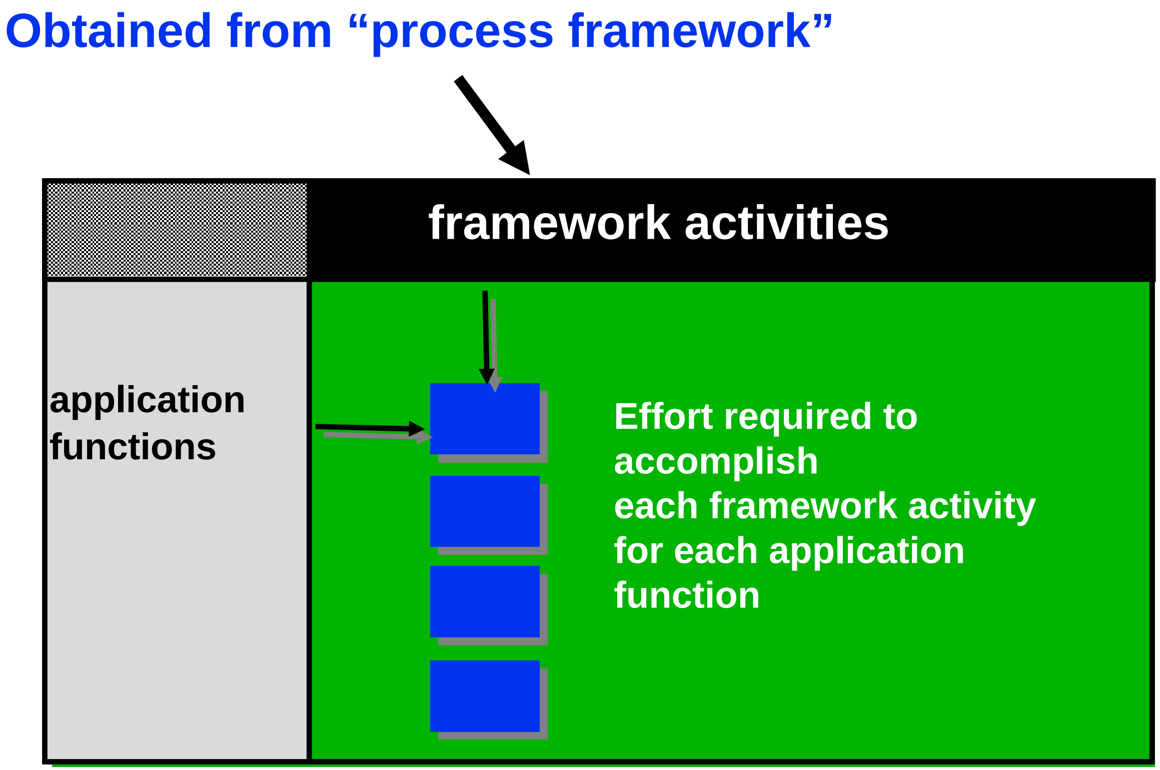
A Common Process Framework

Framework activities

- work tasks
- work products
- milestones & deliverables
- QA checkpoints

Umbrella Activities

Process-based Estimation



Process-Based Estimation

COMMON PROCESS FRAMEWORK ACTIVITIES	customer communication	planning	risk analysis	engineering	
Software Engineering Tasks					
Product Functions					
Text input					
Editing and formating					
Automatic copy edit					
Page layout capability					
Automatic indexing and TOC					
File management					
Document production					

The Task Matrix

Empirical Estimation Models

General form:

effort = tuning coefficient * size $^{\text{exponent}}$

- effort: usually derived as person-months of effort required
- tuning coefficient: either a constant or a number derived based on complexity of project
- size: usually LOC but may also be function point
- exponent: empirically derived

Basic COCOMO 1981 Model

The Basic COCOMO equations:

- $E = ab*(KLOC)^{bb}$
- $D = cb*(E)^{db}$

E is the effort applied in person-months

D is the development time in chronological months

KLOC is the estimated number of delivered lines of code (in thousands).

Software Project	ab	bb	cb	db
Organic	2.4	1.05	2.5	0.38
Semi-detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Organic: relatively small teams developing software in a highly familiar, in-house environment.

Semi-Detached: team members have some experience related to some aspects of the system under development but not others and the team is composed of experienced and inexperienced people.

Embedded: the project must operate within a strongly coupled complex of hardware, software, regulations, and operational procedures, such as real-time systems.

The COCOMO II model

Offers estimating capability at **three levels of granularity**, capturing three stages of software development activity, and providing three levels of model precision:

Prototyping: Applications Composition model, input sized in **Object Points.**

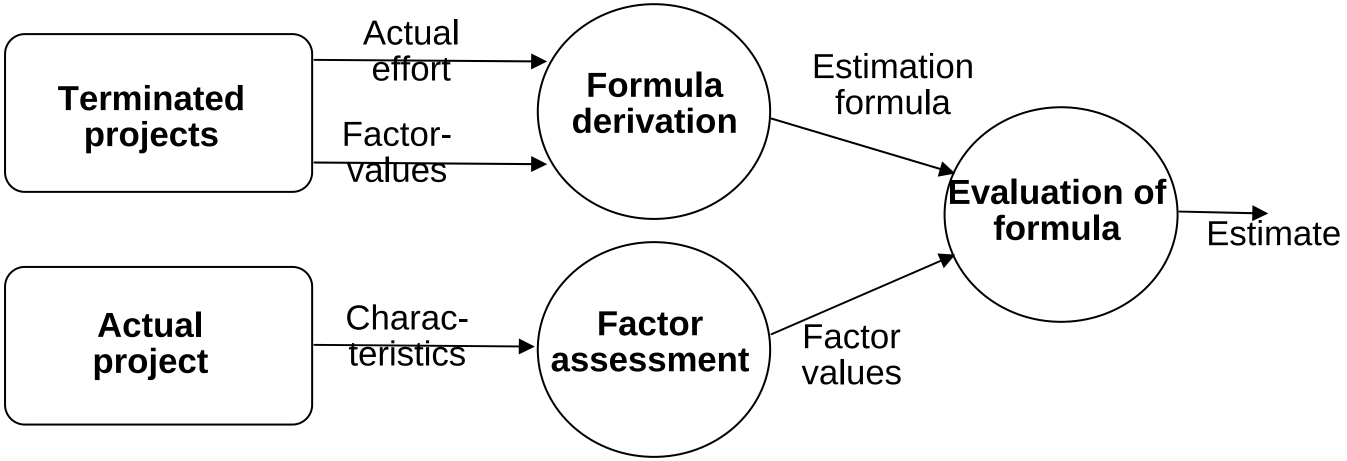
Early Design: input sized in **source statements** or **Function Points,** with **7 cost drivers.**

Post-architecture: input sized in **source statements** or **Function Points,** with **17 cost drivers.**

Five Scale Factors based upon **1) project precedentedness, 2) development flexibility, 3) architecture/risk resolution, 4) team cohesion,** and **5) development process maturity**

Multiplicative Cost Drivers applied at the *component* level.

Estimation: Empirical Models



Estimation Guidelines

Estimate using at least two techniques
Get estimates from independent sources
Avoid over-optimism, assume difficulties
You've arrived at an estimate, sleep on it
Adjust for the people who'll be doing the job —they have the highest impact

Programmer Productivity Variations

In 1968, a study by Sackman, Erikson, and Grant revealed that programmers with the same level of experience exhibit variations of more than 20 to 1 in the time required to solve particular programming problems.

More recent studies [Curtis 1981, DeMarco and Lister 1985, Brian 1997] confirm this high variability.

Many employers in Silicon Valley argue that this productivity variance is even higher today, perhaps as much as 100 to 1.

Sackman et al's Study

TABLE III. RANGE OF INDIVIDUAL DIFFERENCES IN PROGRAMMING PERFORMANCE

Performance measure	Poorest score	Best score	Ratio
1. Debug hours Algebra	170	6	28:1
2. Debug hours Maze	26	1	26:1
3. CPU time Algebra (sec)	3075	370	8:1
4. CPU time Maze (sec)	541	50	11:1
5. Code hours Algebra	111	7	16:1
6. Code hours Maze	50	2	25:1
7. Program size Algebra	6137	1050	6:1
8. Program size Maze	3287	651	5:1
9. Run time Algebra (sec)	7.9	1.6	5:1
10. Run time Maze (sec)	8.0	.6	13:1

Maturity vs. productivity & quality

TABLE 1
MOTOROLA GED PROJECT PERFORMANCE BY SEI CMM LEVEL.

SEI CMM Level	Number of Projects	Quality (In-Process Defects/ MAELOC*)	Cycle Time (X factor)	Productivity (Relative)
1	3	n/a	1.0	n/a
2	9	890	3.2	1.0
3	5	411	2.7	0.8
4	8	205	5.0	2.3
5	9	126	7.8	2.8

*Million assembly-equivalent lines of code

MDD

Model Driven Development

Definitions of "Architecture"

… the highest level concept of a system in its environment

a shared understanding of the system design … a social construct

things that people perceive as hard to change

one of an architect's most important tasks is to remove architecture by finding ways to eliminate irreversibility in software designs.

→

Fowler, 2003

Model Driven Architecture

Model-driven development is simply the notion that we can construct a model of a system that we can then transform into the real thing. (Mellor, Clark & Futagami, 2003)

What is a model?

A model is a coherent set of formal elements describing something (for example, a system, bank, phone, or train) built for some purpose that is amenable to a particular form of analysis, such as:

Communication of ideas between people and machines

Completeness checking

Race condition analysis

Test case generation

Viability in terms of indicators such as cost and estimation

Standards

Transformation into an implementation

Models

Statements about a system under study (SUS)

- A *correct* model makes only true statements
- Often incomplete in concepts and/or details
- Make value judgments about what's important

Characteristics of a useful model

- Abstraction of the SUS
- Understandable
- Accurate
- Predictive
- Inexpensive (relative to the SUS)

Models become primary development artifacts in MDA

Doug Tolbert, 2004

Notorious Failures: CASE

In the 1980's, CASE technologies promised to marry design and implementation technologies

Multiple failures

- Model-to-implementation mapping abstractions weak
- Immature enabling technologies
  - Code generators, middleware, deployment
- Vendor hype exceeded capabilities
- Visible product failures (AD/Cycle)

Fueled market skepticism about value of underlying technologies

Doug Tolbert, 2004

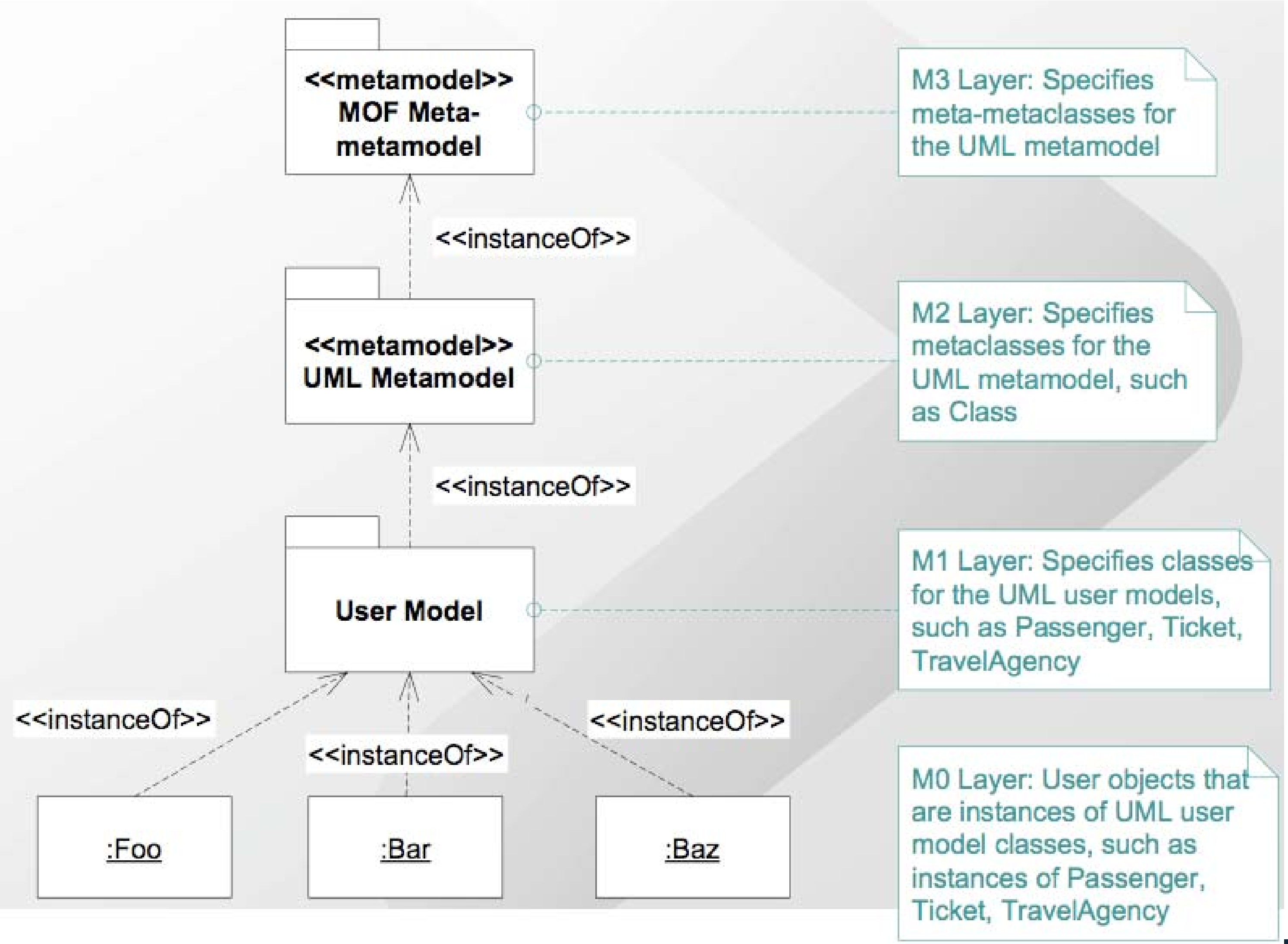
Mellor et al. 2003

... model-driven development offers the potential for automatic transformation of high-level abstract application-subject matter models into running systems

... modeling technology has matured to the point where it can offer significant leverage in all aspects of software development

... in an increasing number of application areas, you can generate much of the application code directly from models

OMG –Metamodel Architecture



Point, Counterpoint

MDA is the next logical evolutionary step to complement 3GLs in the business of software engineering
Axel Uhl, 2003

Has it been 10 years already? The "uber-modeling tool" vision rears its ugly head yet again
Scott Ambler, 2003

Ambler, 2003

Generative MDD, epitomized by the Object Management Group's Model Driven Architecture, is based on the idea that people will use very sophisticated modeling tools to create very sophisticated models that they can automatically "transform" with those tools to reflect the realities of various deployment platforms. Great theory—as was the idea that the world is flat.

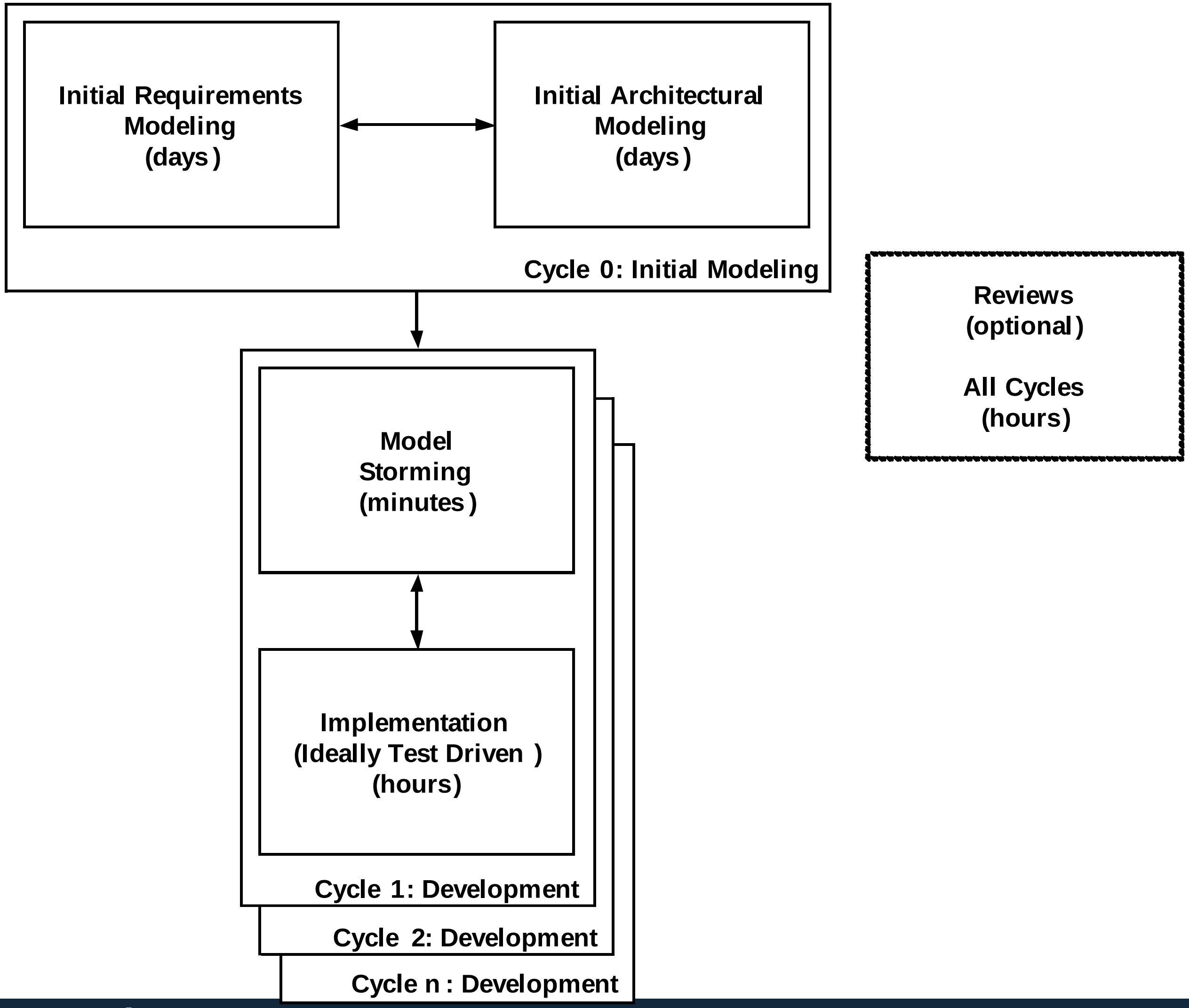
... I believe that modeling is a way to think issues through before you code because it lets you think at a higher abstraction level.

Agile MDD (AMDD) Project Level

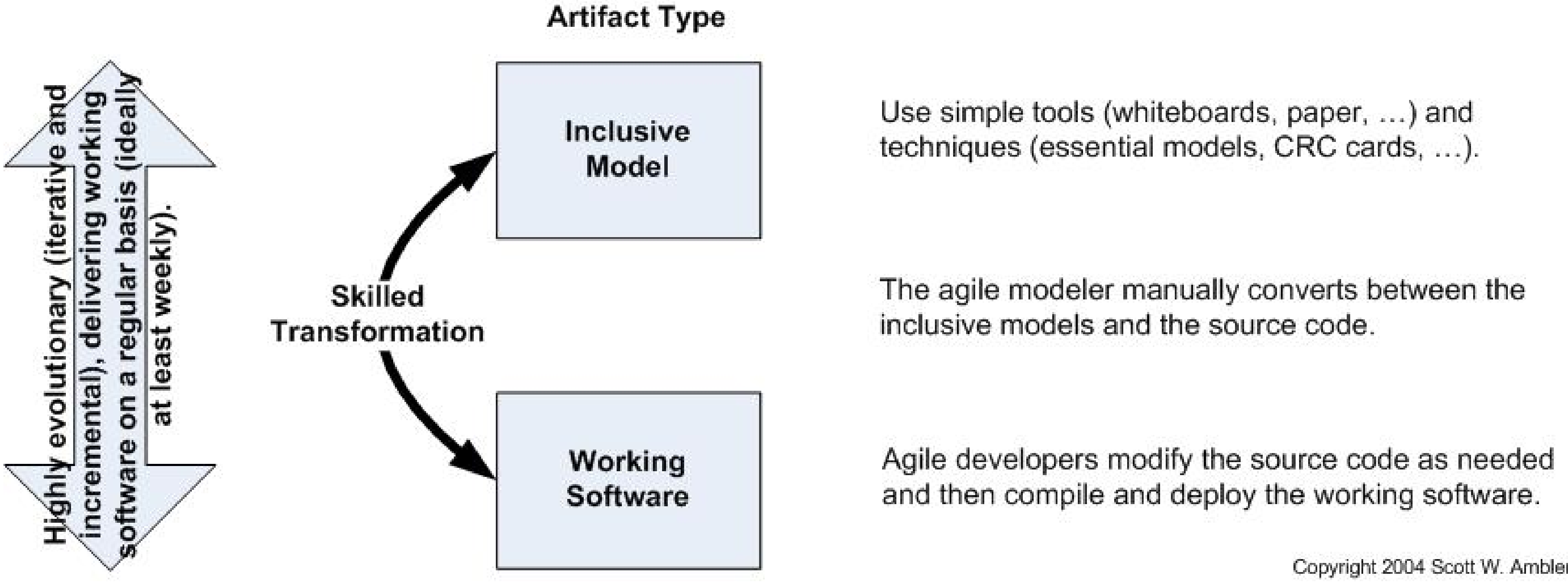
Goals: Gain an initial understanding of the scope, the business domain, and your overall approach.

Goal: Quickly explore in detail a specific issue before you implement it.

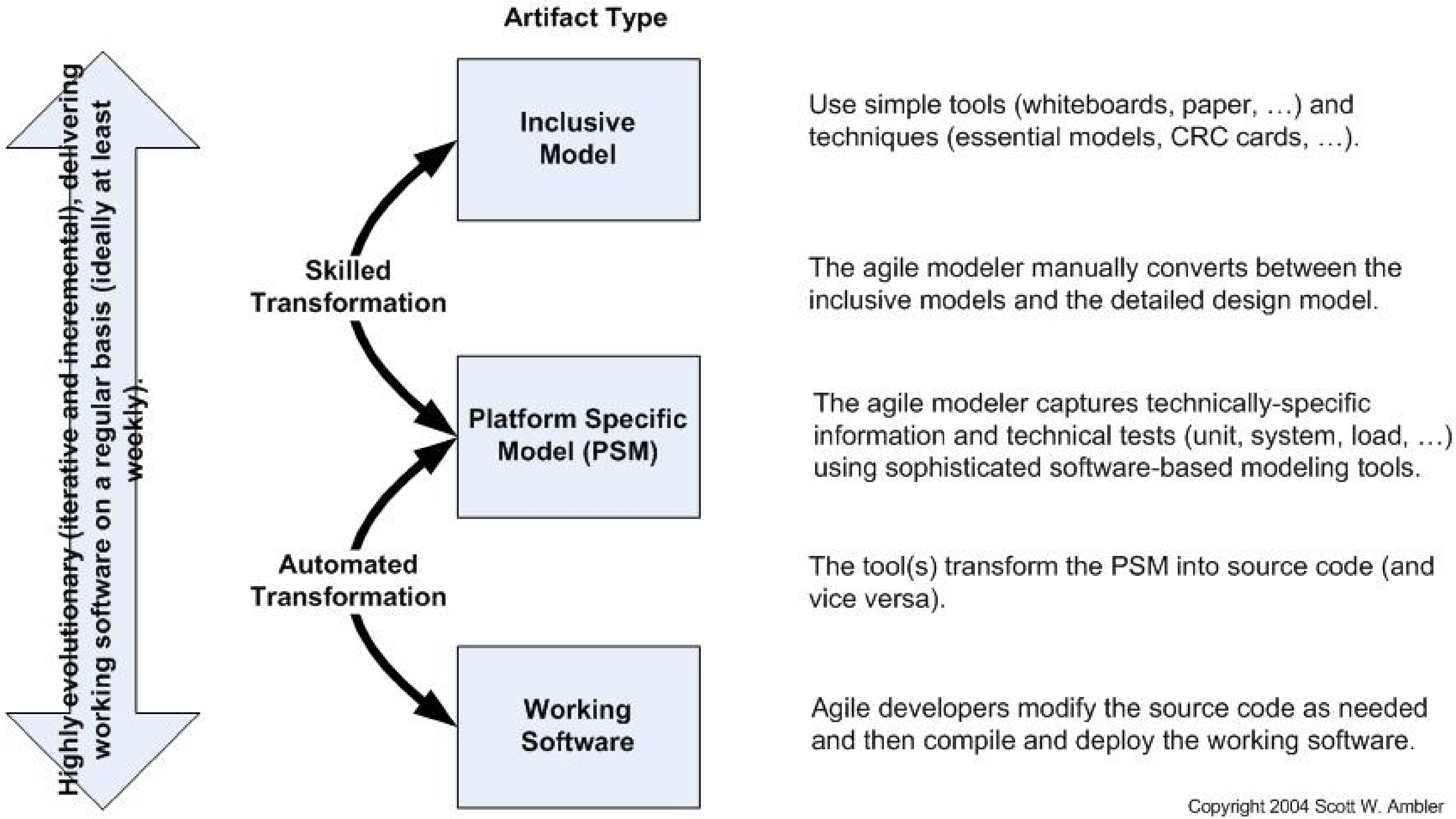
Goal: Develop working software in an evolutionary manner.



AMDD – Simple Approach



AMDD – CASE Approach



AMDD – Agile MDA Approach