Engineering the Object-Oriented Software Process: OPEN and MeNtOR

Presented by
Tony Simons

Overview

- **Where have OO Methods come from?**
- **Where are OO Methods going?**
- **Beyond Methods..... to a Process Architecture approach to OO development**
- **Context & Background to OPEN and *MeNtOR*?**
- **A Brief Tour of OPEN/*MeNtOR***
  - **Fundamentals of OPEN/*MeNtOR***
  - **Software Engineering Process**
  - **Software Engineering Process Architecture**
  - **Summary**
- **Deploying an OO Process**
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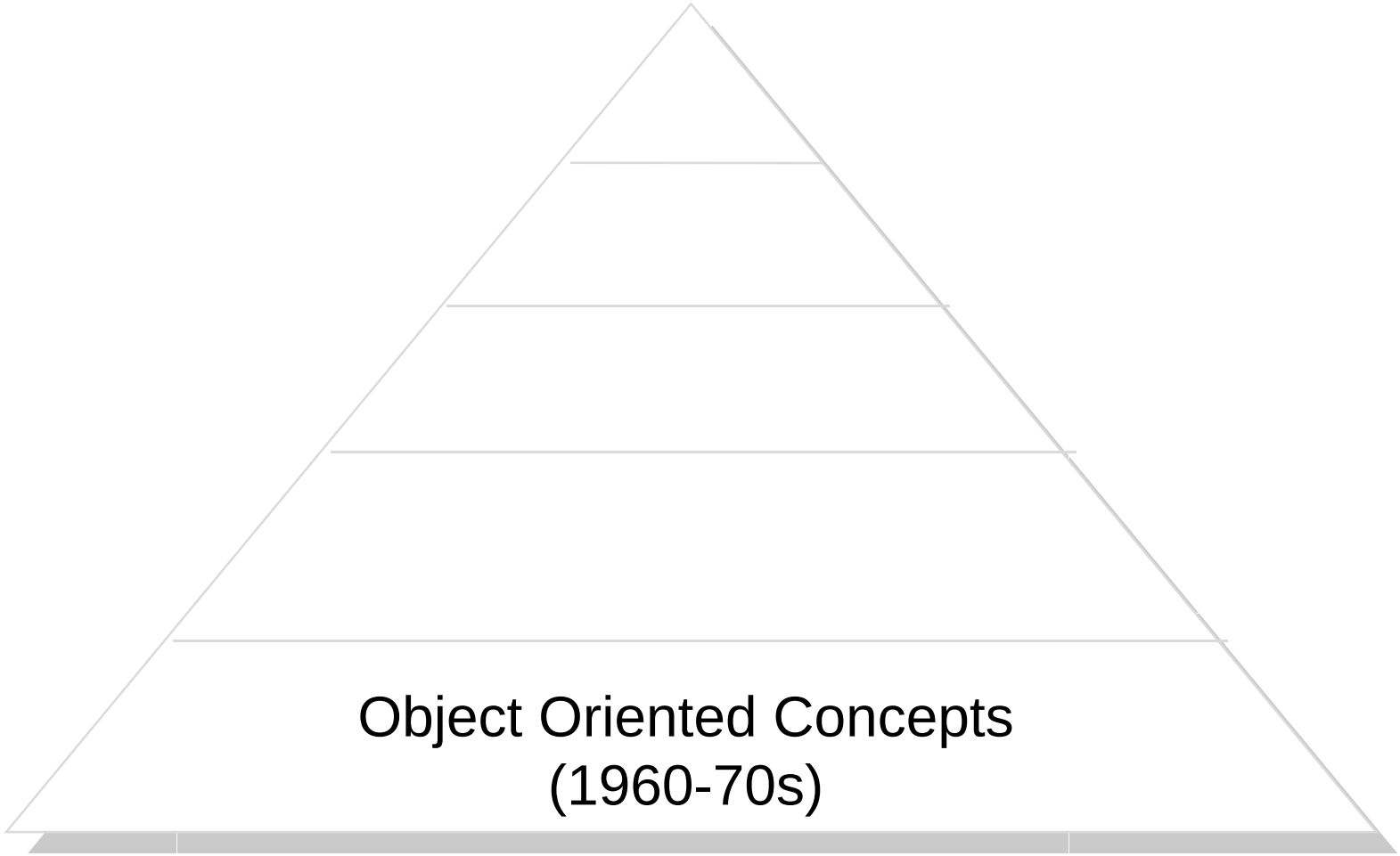
Where Did It All Begin?

- **1960s Simula 67 - OO Concepts**
  - **class**
  - **object**
  - **inheritance**
  - **relationships**
  - **polymorphism**
- **Refined and applied in 1970s with Smalltalk**
- **Semantic data modelling**

Foundational Concepts



What did we do?

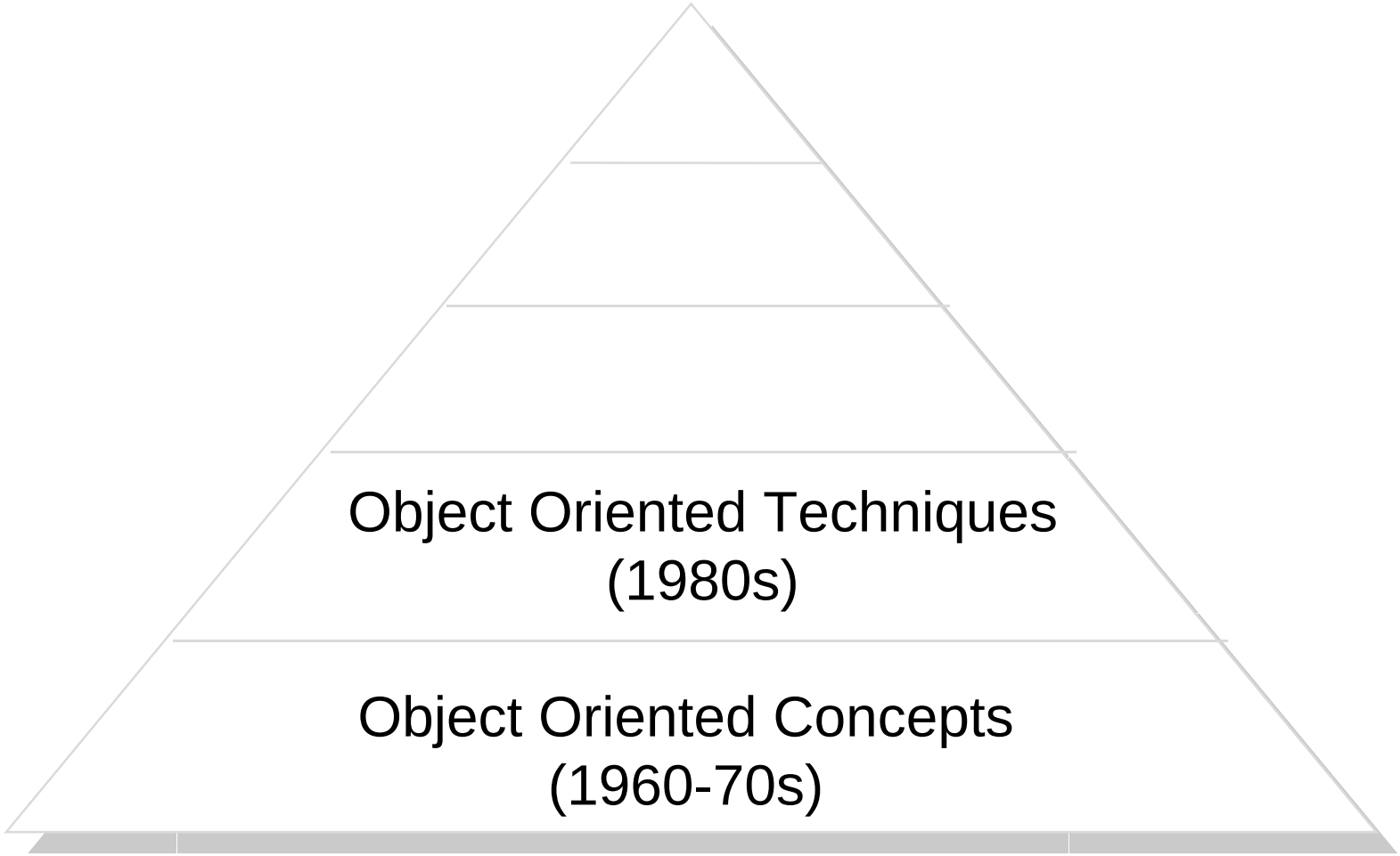
- **Limited commercial application**
  - **mainly R&D labs**
  - **specialised applications**
  - **small to medium sized programs**
- **Developed program level support material**
  - **C++/Smalltalk coding standards and guidelines**
  - **programming language review checklist of what to look for and what not to do**
  - **OO design tips and hints**

Methodology = set of programming level standards, tips and hints

From Concepts to Techniques

- **1980s Booch/Buhr/Seidewitz - OO Techniques**
  - **Object modelling**
  - **Interaction diagrams**
  - **CRC carding**
  - **scenario analysis**
- **Evolution from concepts to techniques that proceduralise activities of OO design**
- **Limited interaction with the dominant Information Engineering methods**

Concepts to Techniques



What did we do?

- **Applying OO development to commercial application in certain domains e.g Telecommunications, CAD/CAM, GIS**
- **Developed guidelines for design techniques**
  - **formalised the design documentation**
  - **formalised the techniques used**
  - **provided support for the techniques**

Methodology = set of design level techniques, guidelines supporting documentation

Techniques to “Methods”?

- **Early 1990s - OO “Methods”**
- **Whole series of published text book “methods”**
  - **Booch 1991**
  - **Rumbaugh et al 1991**
  - **Jacobson et al 1992**
  - **Wirfs-Brock et al 1990**

Explosion of OO “Methods”

- Booch: Booch, 1991/1994
- OOA/OOD: Coad and Yourdon, 1990
- Syntropy: Cook and Daniels, 1995
- OSA : Embley et al., 1992
- ADM3/4 : Firesmith, 1993
- Fusion : Coleman et al 1994
- OBA : Goldberg and Rubin, 1992
- SOMA : Graham, 1992/5
- MOSES : Henderson-Sellers/Edwards, 1994
- Objectory : Jacobson et al., 1992
- Ptech: Martin and Odell, 1992
- Mentor : Object Oriented Pty Ltd,1993
- BON : Walden and Nerson, 1992
- Synthesis: Page-Jones et al., 1990
- ROOM : Selic et al., 1992
- OMT : Rumbaugh et al., 1991
- Shlaer and Mellor, 1990
- RDD : Wirfs-Brock et al., 1990
- Others

Booch Method

- **Booch (1991, 1994)**
  - **Object Oriented Analysis and Design With Applications, Benjamin Cummings.**
- **Method summary**
  - **Developed from an Ada Background**
  - **Now oriented to C++ although language-independent**
  - **Supports detailed design issues and some real-time issues**
  - **Process includes Micro and Macro lifecycles**
  - **Documentation through:**
    - **Scenarios, Class Diagram, State Transition Diagram, Object Diagram**

OOSE/Objectory

- **Jacobson et al. (1992)**
  - **Object Oriented Software Engineering: A Use Case Driven Approach, Addison-Wesley**
- **Method summary**
  - **One of the most mature and complete approaches available**
  - **Developed from Ericsson Research Labs**
  - **Supports detailed analysis and design process with complete process documentation**
  - **Discusses some project management issues**
  - **Documentation through:**
    - **Use Cases, Class Diagram, Interaction Diagram, Requirements, Analysis and Design Model**

Object Modelling Technique (OMT)

- **Rumbaugh et al. (1991)**
  - **Object Oriented Modelling and Design, Prentice-Hall**
- **Methods Summary**
  - **Developed at GE Concepts Centre**
  - **Evolutionary approach from SAD**
  - **Probably currently the most popular method in use**
  - **Supports detailed analysis issues particularly in regard to the data modelling aspects**
  - **Documentation through:**
    - **Scenarios, Class Diagram, State Transition Diagra Data Flow Diagram**

OOA&D - Coad and Yourdon

- **Coad and Yourdon (1991)**
  - **Object Oriented Analysis, Prentice-Hall**
  - **Object Oriented Design, Prentice-Hall**
- **Methods Summary**
  - **Information Engineering background**
  - **Language-independent**
  - **Simple approach**
  - **Stronger in analysis, emphasises data component**
  - **Documentation through:**
    - **OOA Model, State Transition Diagram,**
    - **Message Service Chart**

Responsibility Driven Design (RDD)

- **Wirfs-Brock et al. (1990)**
  - **Designing Object Oriented Software, Prentice-Hall**
- **Method summary**
  - **Developed at Tektronix**
  - **Smalltalk-oriented**
  - **One of the earliest approaches with quite widespread appeal**
  - **Documentation through:**
    - **Hierarchy Diagrams, Collaboration Graphs**

What Did Industry do?

- **Industry began to embrace new OOA&D techniques for client-server, GUI, and PC development**
- **Many new industry sectors e.g Banking, Insurance, Health**
- **Applied new OO concepts and languages**
  - **C++**
  - **Smalltalk**
- **Applied new OO design techniques**
  - **CRC carding**
  - **Use case analysis**
  - **Interaction diagramming**

What Did We Learn?

- **The textbook "methods" are not enough**
  - **limited scope**
  - **focus on design**
  - **no single approach is complete**
  - **don't deal with the "hard" issues of project management, quality assurance, project practicalities**
- **Needed to develop organisation-specific OO methods**
  - **Integrating OO techniques**
  - **Integrating to traditional methods**
  - **Make OO techniques commercially robust**

Methodology = client specific methods that covered the lifecycle requirements of the particular project

Object-Oriented Methods

- **The well-known OO methods are:**
  - **Booch**
  - **OMT**
  - **RDD**
  - **Coad and Yourdon**
  - **OOSE**

*Most well-known "OO methods" are not really methods at all but rather a set of **techniques**.*

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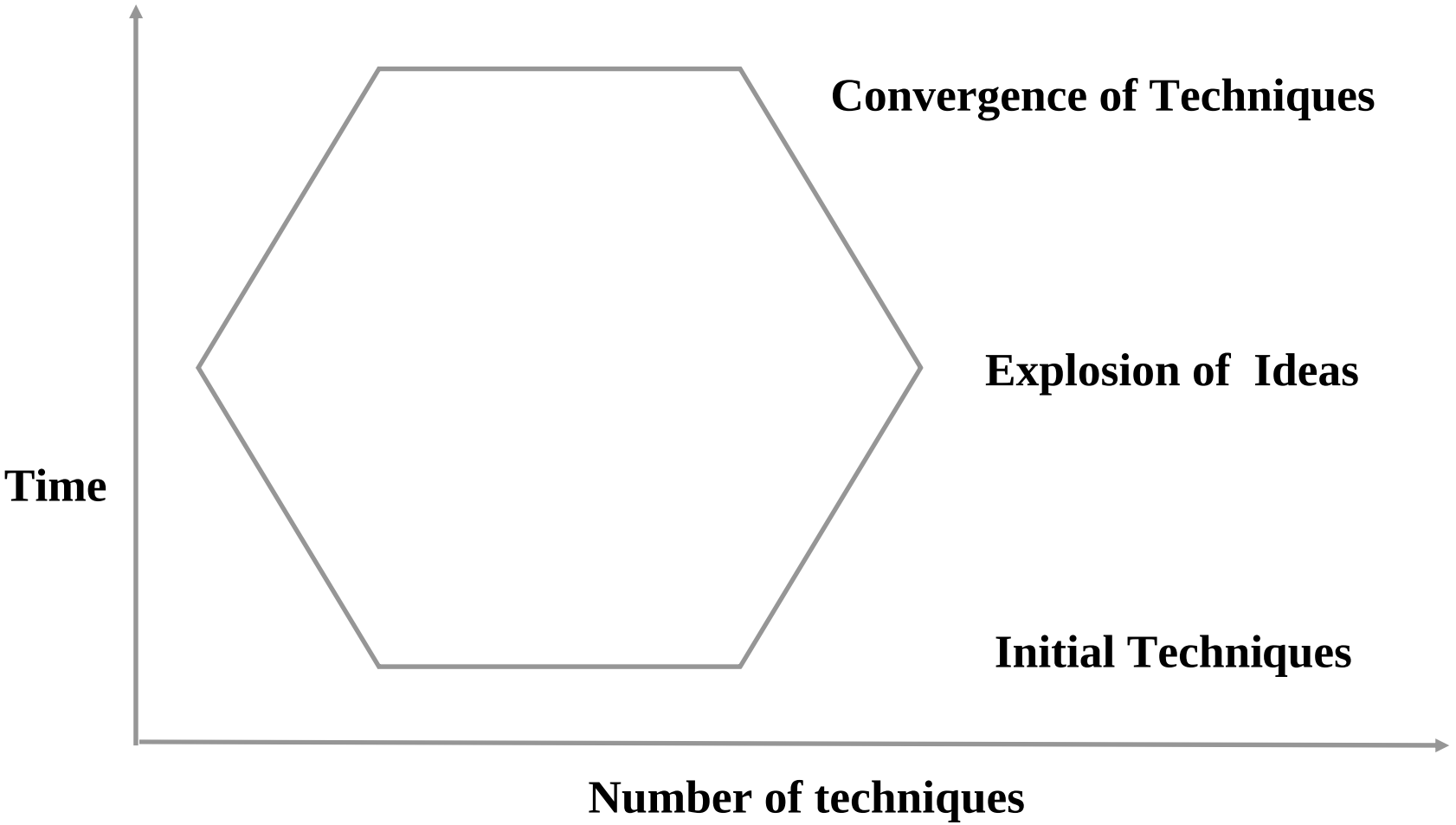
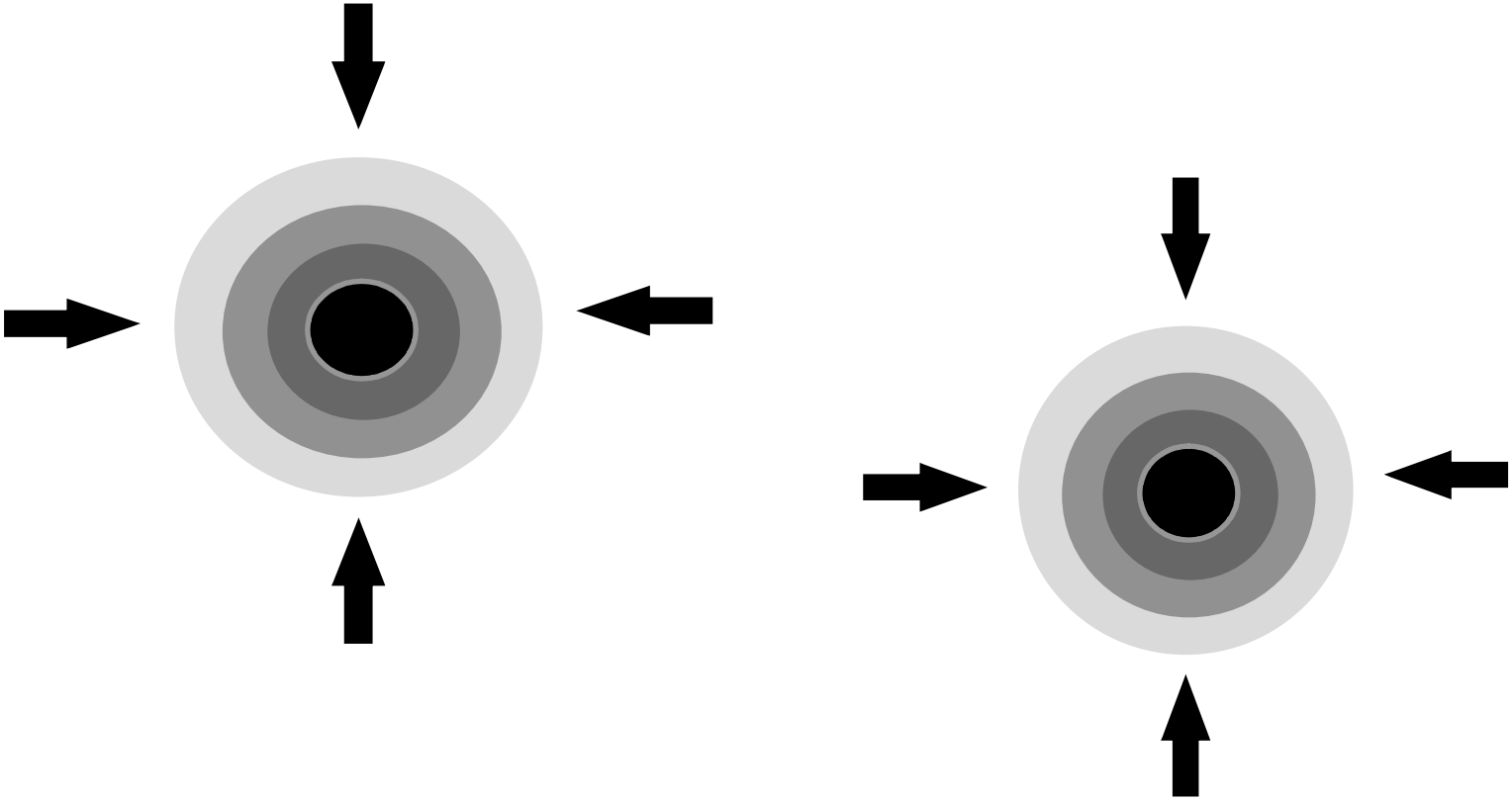
Convergence of Techniques

- **Basic agreement on:**
  - **Concepts**
  - **Terminology**
  - **Techniques**
- **Waging of Peace in the notation wars with activities such as the UML/OPEN notation**
  - **Booch and Rumbaugh merging notation**
  - **Jacobson joining the approach**
  - **OPEN initial involvement**
- **Common Object oriented Methodology MetaModel Architecture (Henderson-Sellers et al 1994)**

Maturing of the Basics



Coalescence of Techniques



Increasing Focus on Process

- **Move from concepts and techniques to lifecycles and processes**
  - **Jacobson et al**
  - **Shlaer/Mellor**
  - **OPEN and MeNtOR**
- **Move to consider larger scale issues**
  - **Organisation structure**
  - **Reuse strategies**
  - **Component based development**
  - **Costing models**

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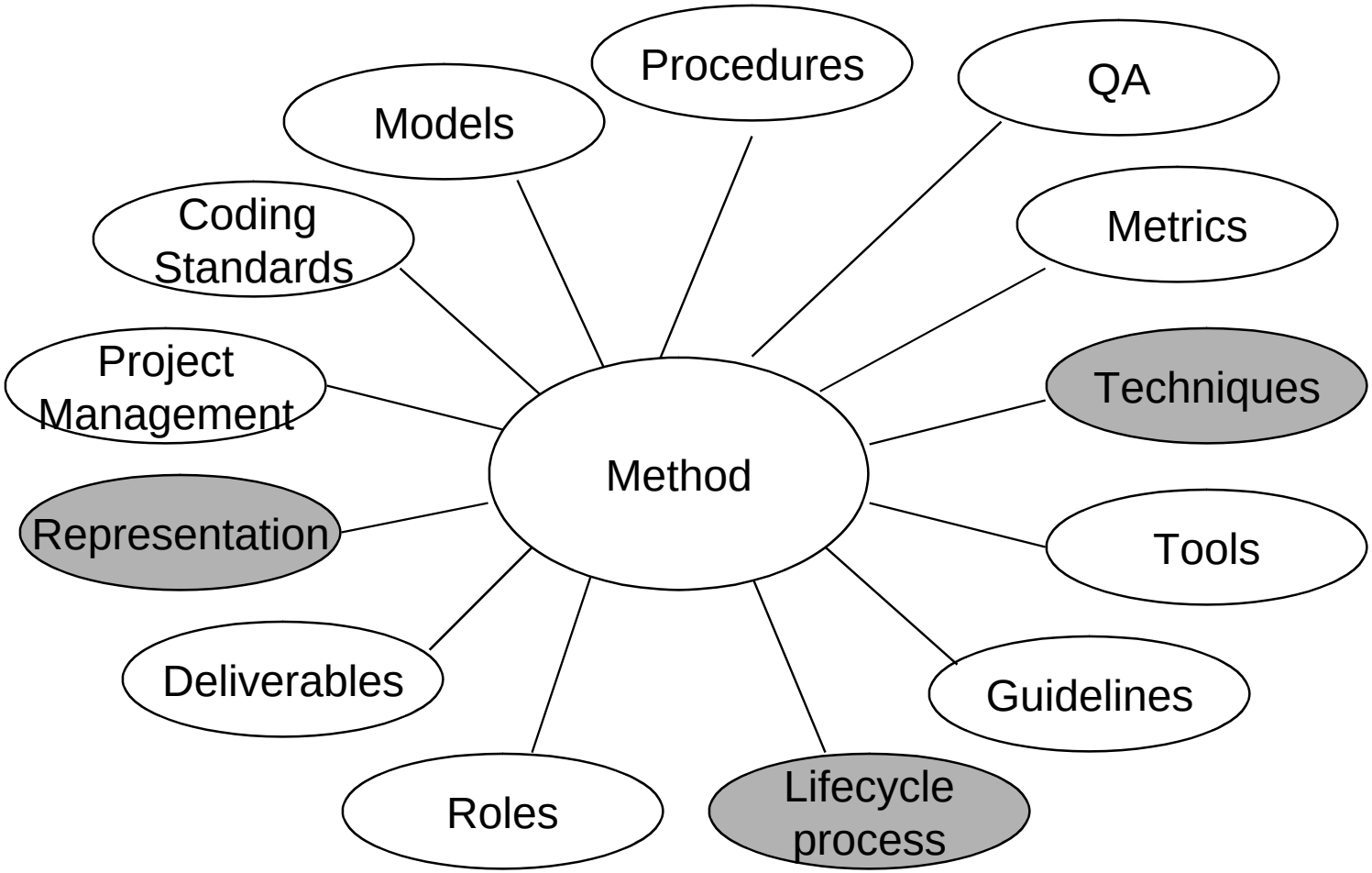
What is a Method?



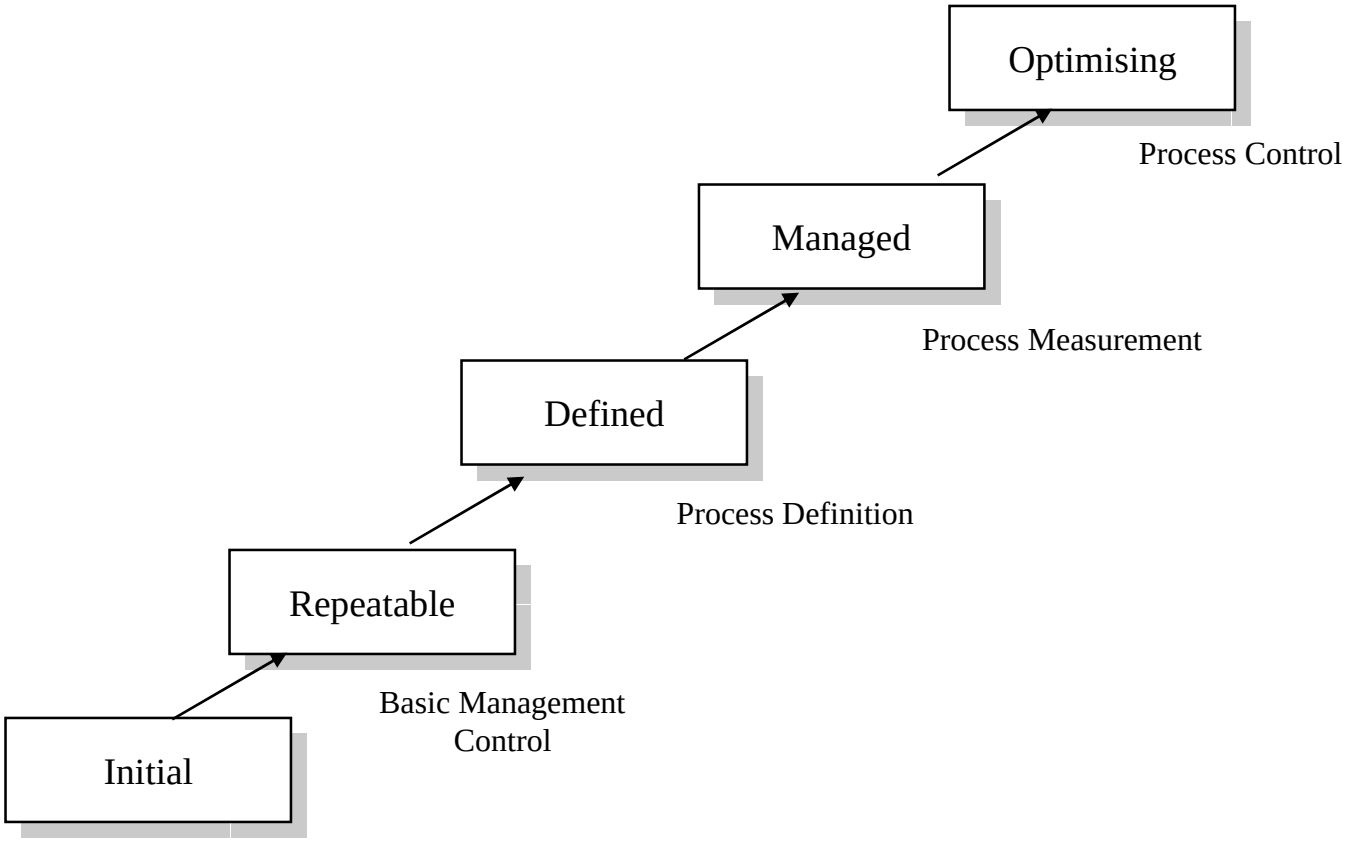
What is the Role of a Method?

- **Organisation Standards**
  - **Process**
  - **Deliverables**
- **Guidance & Support**
  - **Techniques**
  - **Guidelines**
- **Monitoring & Control**
  - **Project Management**
  - **Quality**
- **It is NOT a recipe book**
  - **Access to business knowledge is mandatory**
  - **Creativity in design is still essential**

- **A method should thus provide a standard, yet flexible, framework for developing systems, that blends engineering rigour with engineering creativity**
- **View a method as a street directory providing the traveller with a guide to a successful outcome**
- **Using a method permits success to be repeated (and failures to be avoided)**

Process Maturity Levels

- **Capability Maturity Model (CMM)**



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Context

- **OPEN = Object Oriented Process, Environment and Notation**
- **OPEN is:**
  - **a Public Domain Object Oriented Software Process**
  - **the open (freely available) "*lite*" version of MeNtOR**
- **MeNtOR is an industrial strength, commercial, object oriented software process**

OPEN Consortium

- **OPEN is a group of OO professionals and researchers committed to the development of OO software processes**
- **Consists of:**

B. Henderson-Sellers

I.M. Graham

D. Firesmith

M. Page-Jones

E. Yourdon

also: C. Atkinson, J. Bezivin, E. Colbert, P. Desfray, R. Due, D. Duffy, R. Duke, Y. Gill, K. Hung, G. Low, J. McKim, D. Mehandjiska-Stavrova, S. Moser, K. Nguyen, A. O'Callaghan, D. Patel, D. Rawsthorne, A.J.H. Simons, M. Singh, P. Swatman, B. Unhelkar, K. Whitehead, A. Wills, R.Winder, H. Younessi, H. Ziv

Object Oriented Pty Ltd

- **Object Oriented Pty Ltd is Australia's first - and leading - consulting organisation specialising exclusively in Object Technology**
- **Object Oriented Pty Ltd is the supplier of MeNtOR products and services**

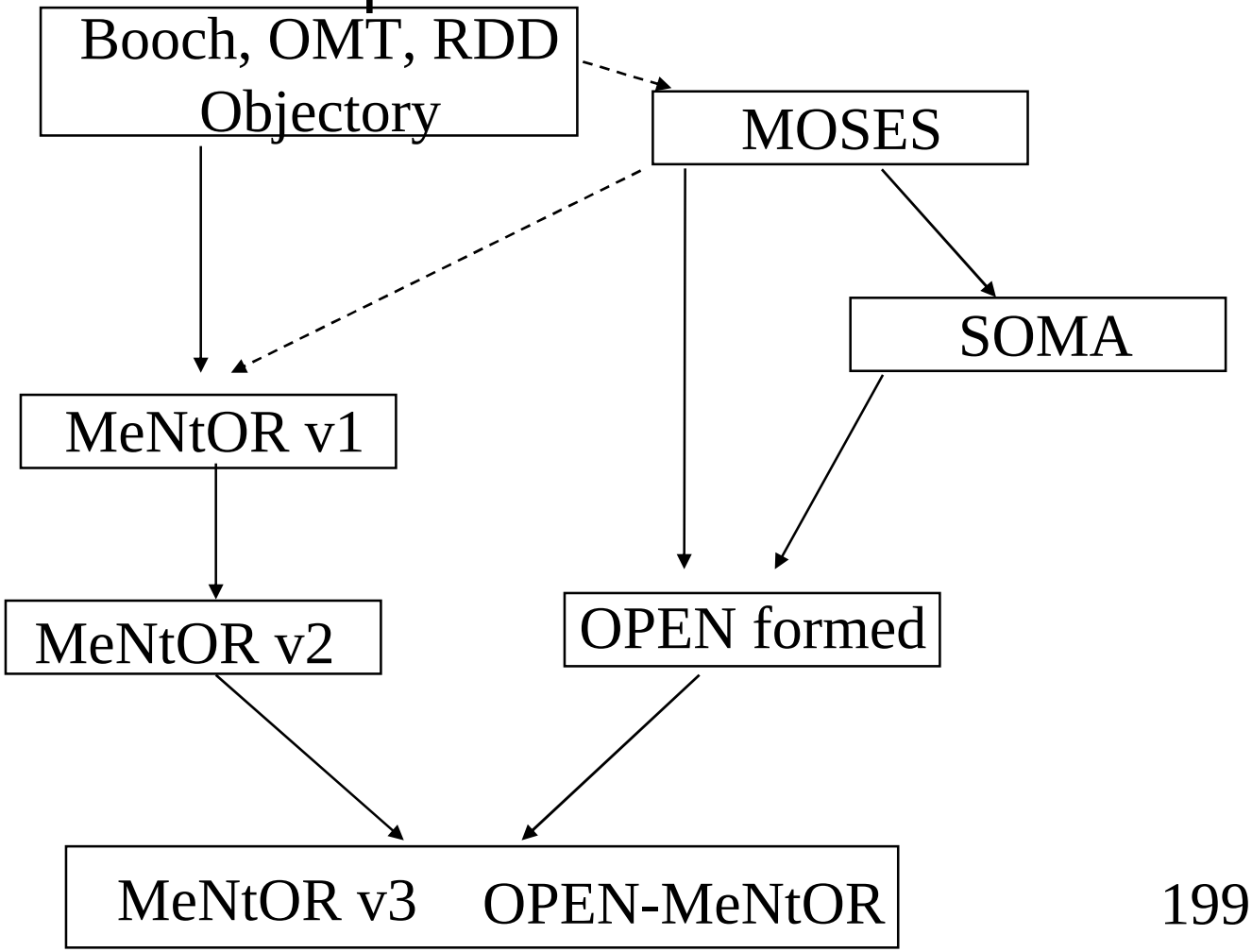
OPEN and MeNtOR

- **Provide a *complete* and *disciplined* process for object-oriented software engineering**
- **Embody the best of Booch, OMT, RDD, OOSE, MOSES, SOMA and others**
- **Are largely notation, language and tool independent**
- **Support iterative and incremental development**
- **Promote *Software Process Engineering (i.e. engineering the software process)***

OPEN

- **OPEN is the *public domain* version of MeNtOR - an industrial strength object oriented software process**
- OR **MeNtOR is a commercial implementation of OPEN**
- **OPEN is a *level 2 methodology* suitable for trialling OO methods and for small projects**

The Development of OPEN-MeNtOR



History of OPEN

- **COMMA project (funded late 1994) which, in turn, encouraged the merger of MOSES and SOMA and later Martin/Odell October 1995 OOPSLA**
- **1995/6 interest from other major methodologists (e.g. Firesmith, Page-Jones, Reenskaug, Selic, Yourdon). Other eminent OT gurus join OPEN collaborative.**
- **First publication -- IEEE Computer, April 1996**

The Development of *Mentor*

- ***Mentor* was initially an internal handbook used by OOPL consultants.**
- ***Mentor* has been developed based on OOPL's extensive experience with clients and our software house over the past 6 years.**
- **Embodies 30 person-years effort**

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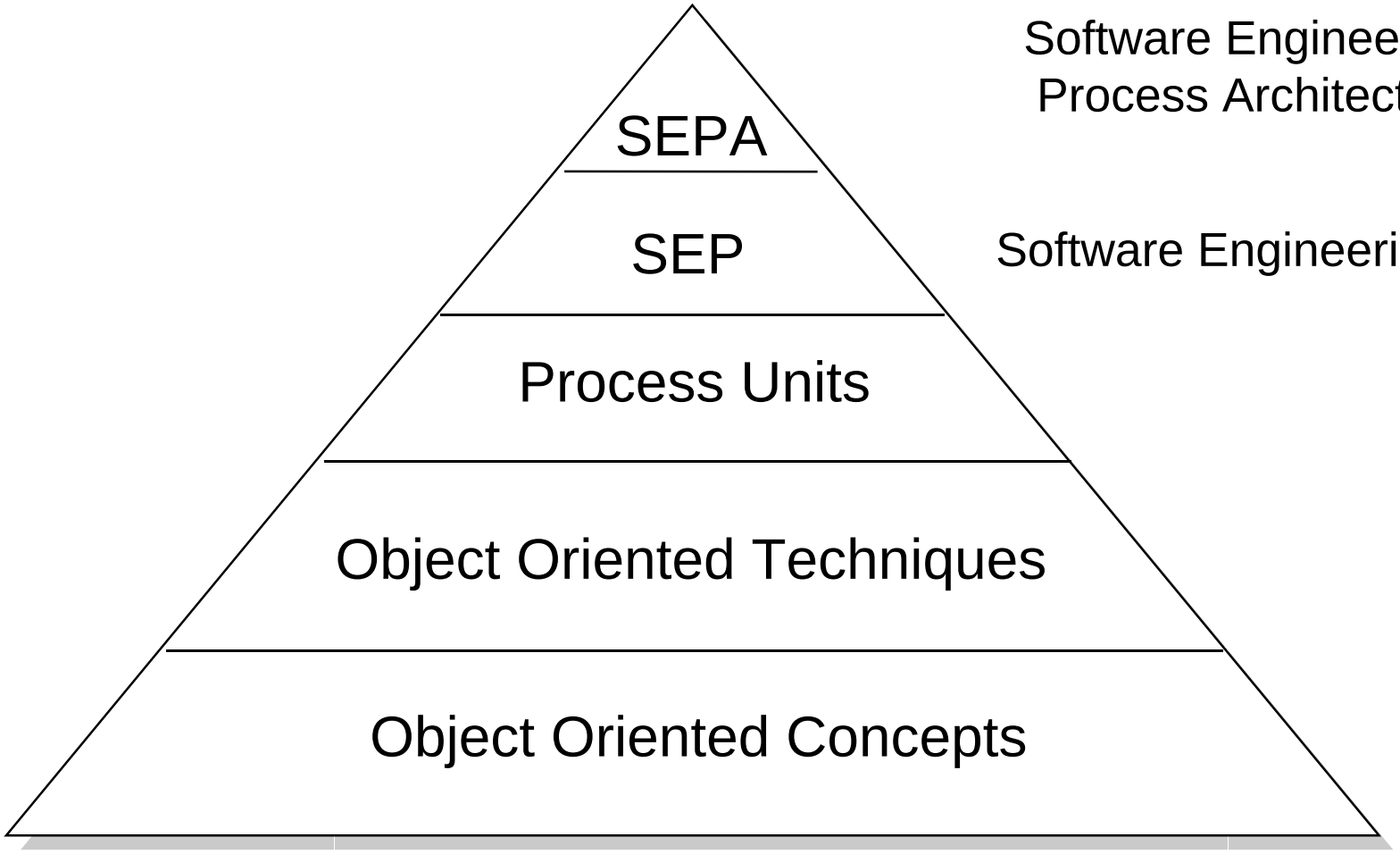
Fundamentals of OPEN and MeNtOR



Software Engineering Process Architecture

Software Engineering Process

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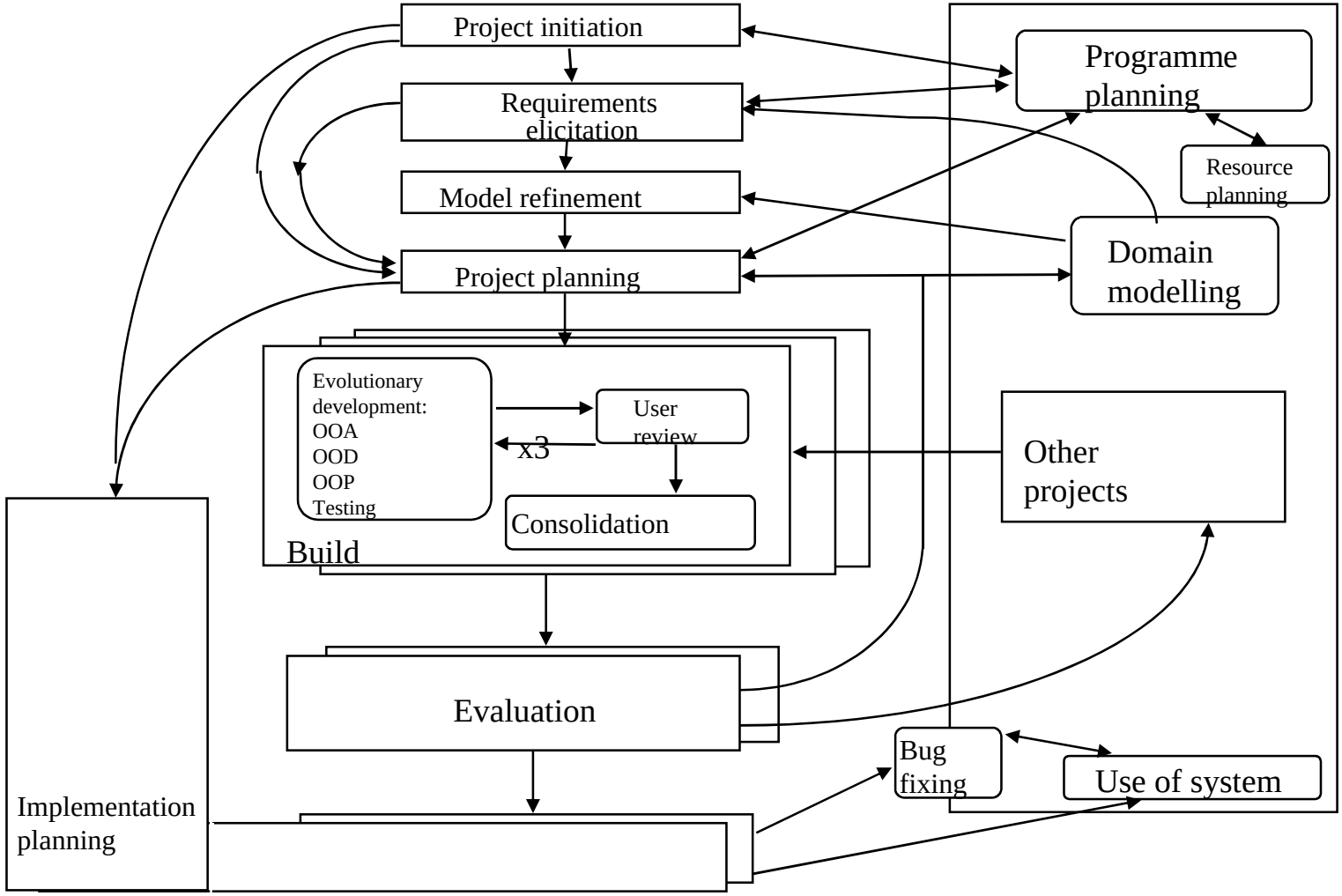
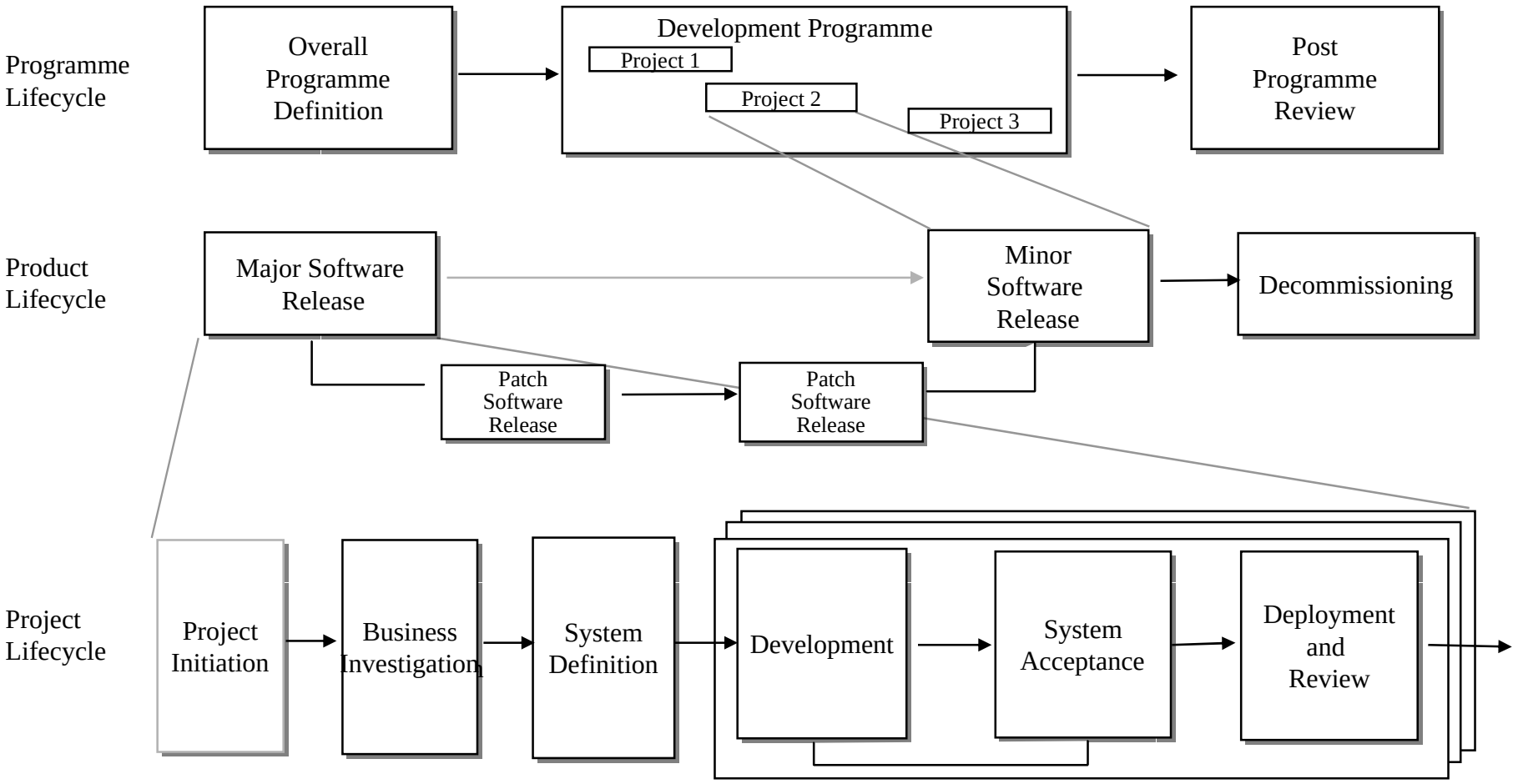
Software Engineering Process

- **SEP is a time sequenced set of activities which transform a user's requirements into software**
- **= *Method***
- **Provides a tested and well defined approach to developing object-oriented software systems**

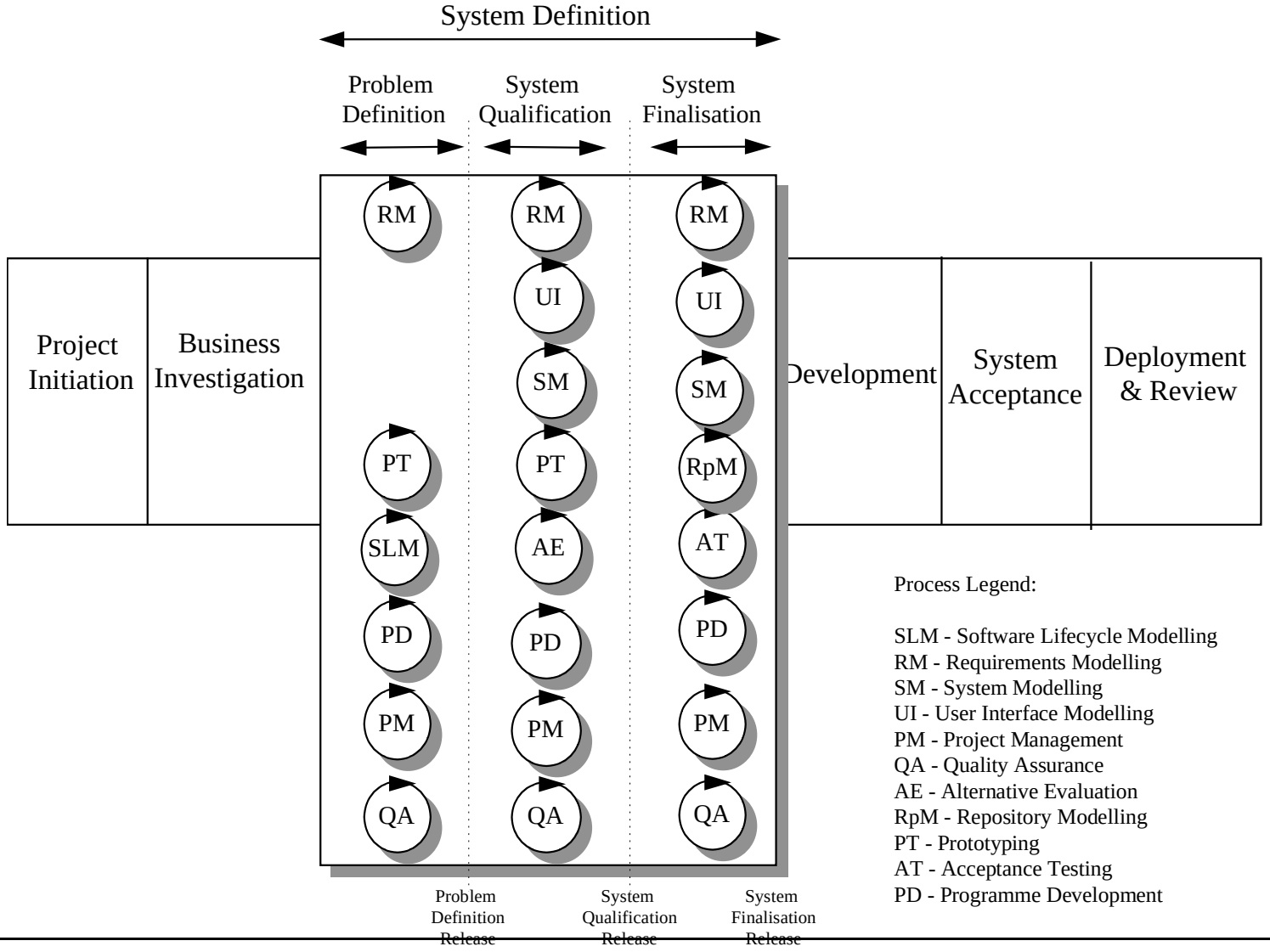
An OPEN/MeNtOR SEP



Mentor's Software Engineering Process

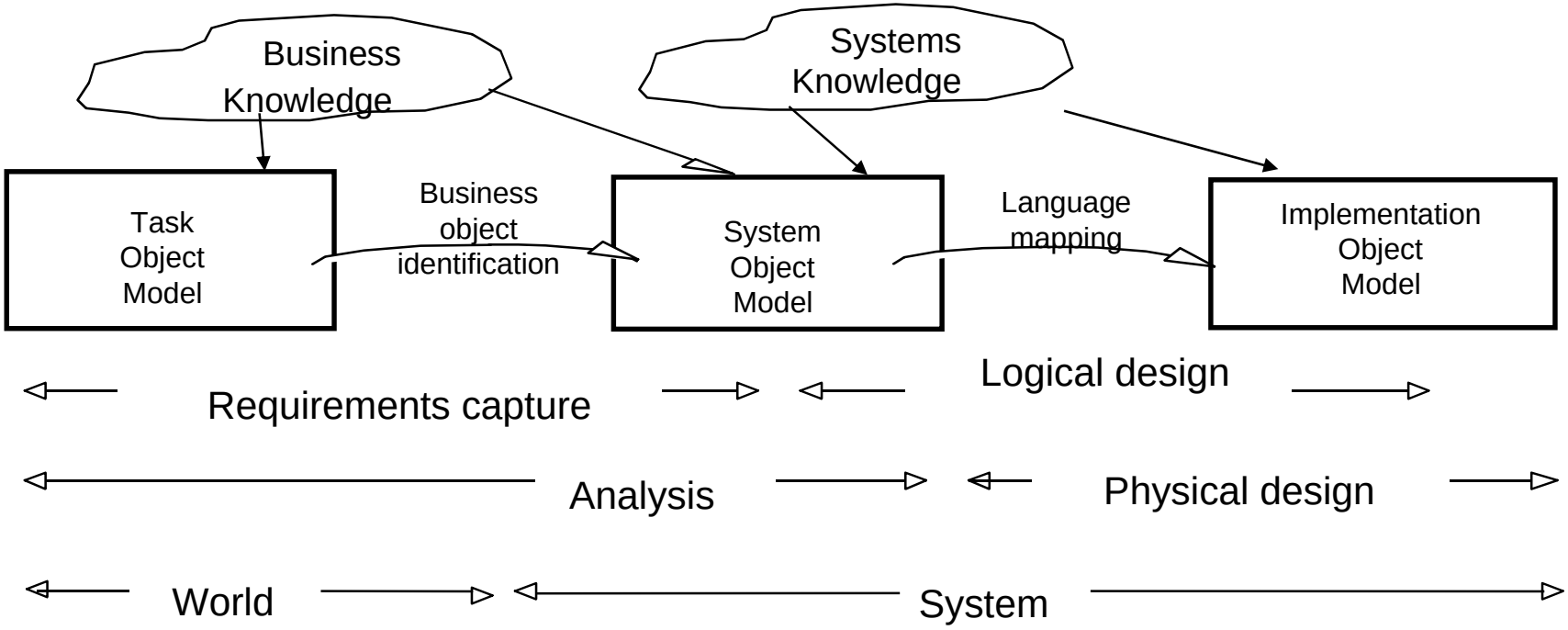


Mentor's System Definition Phase

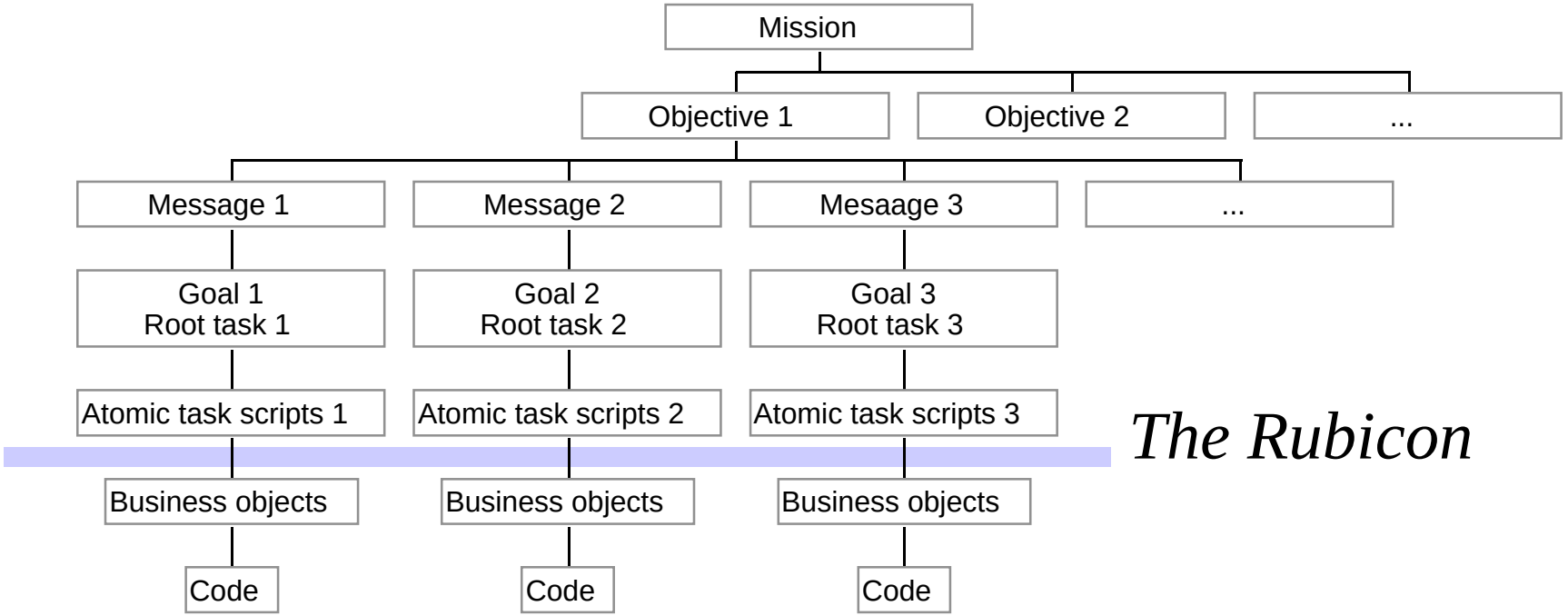


Seamlessness

Object Model Sequence



The leap from world model to the system model



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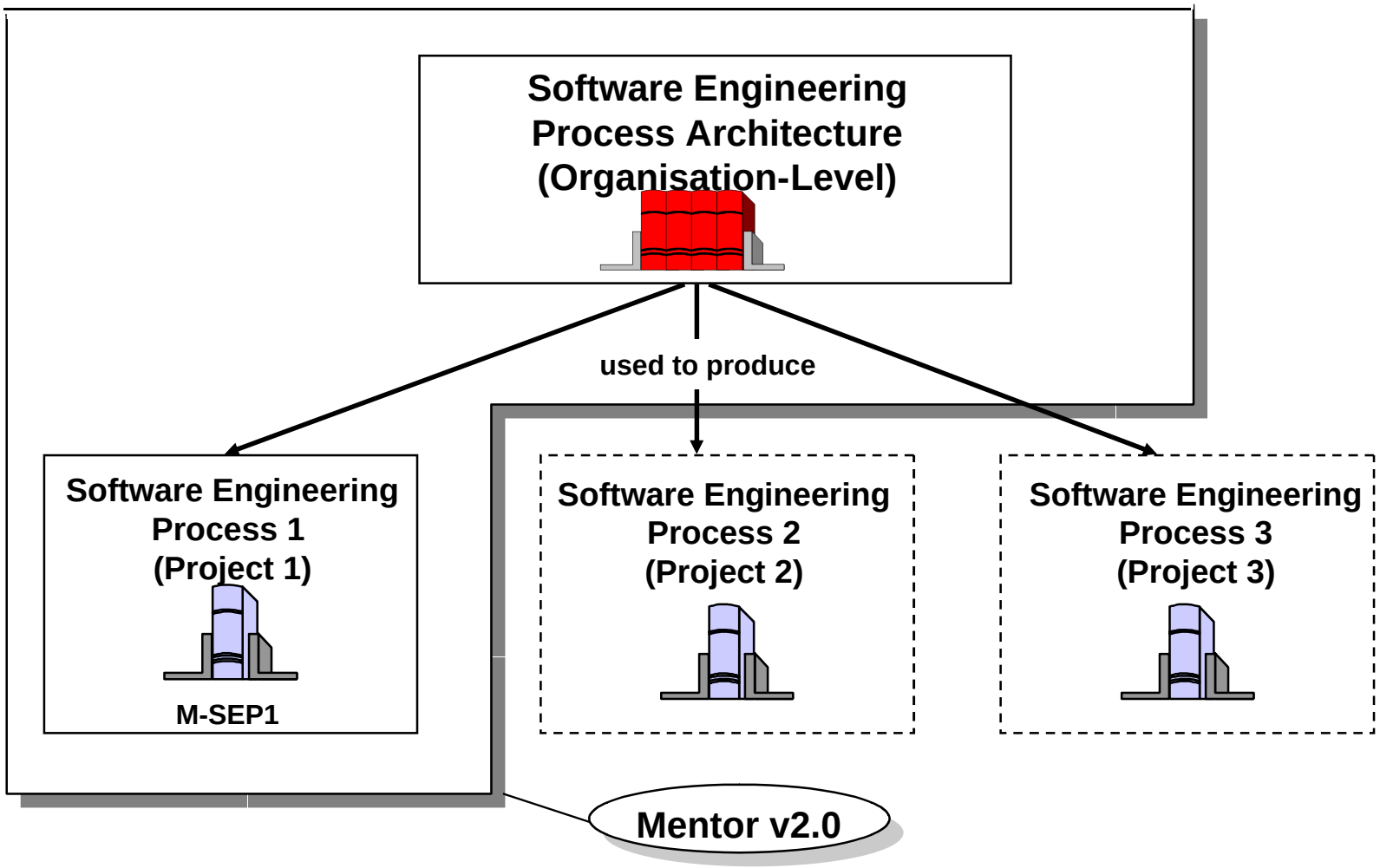
Software Engineering Process Architecture

- **Defines the *constructs* that combine to form a Software Engineering Process:**
  - **Reusable *Process Units***
  - **Software *Lifecycle Models***
- **Defines the *rules* that govern how these constructs may be combined**

The Big Picture



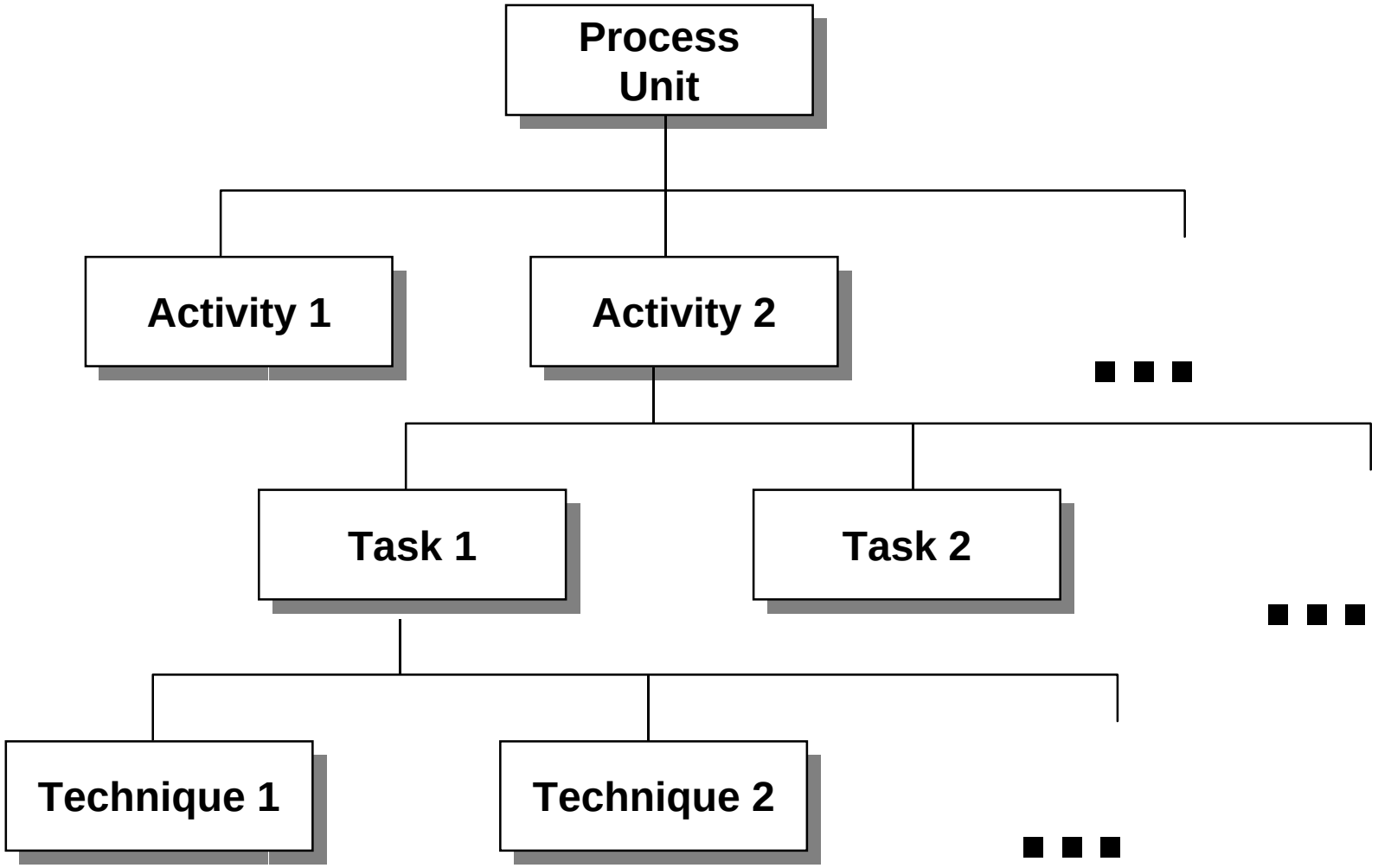
A Process Unit

- **Defines a set of related *activities* which are performed during a project**
- **Defines the *inputs* to generate the *outputs* (called *deliverables*) through the use of a series of *activities***

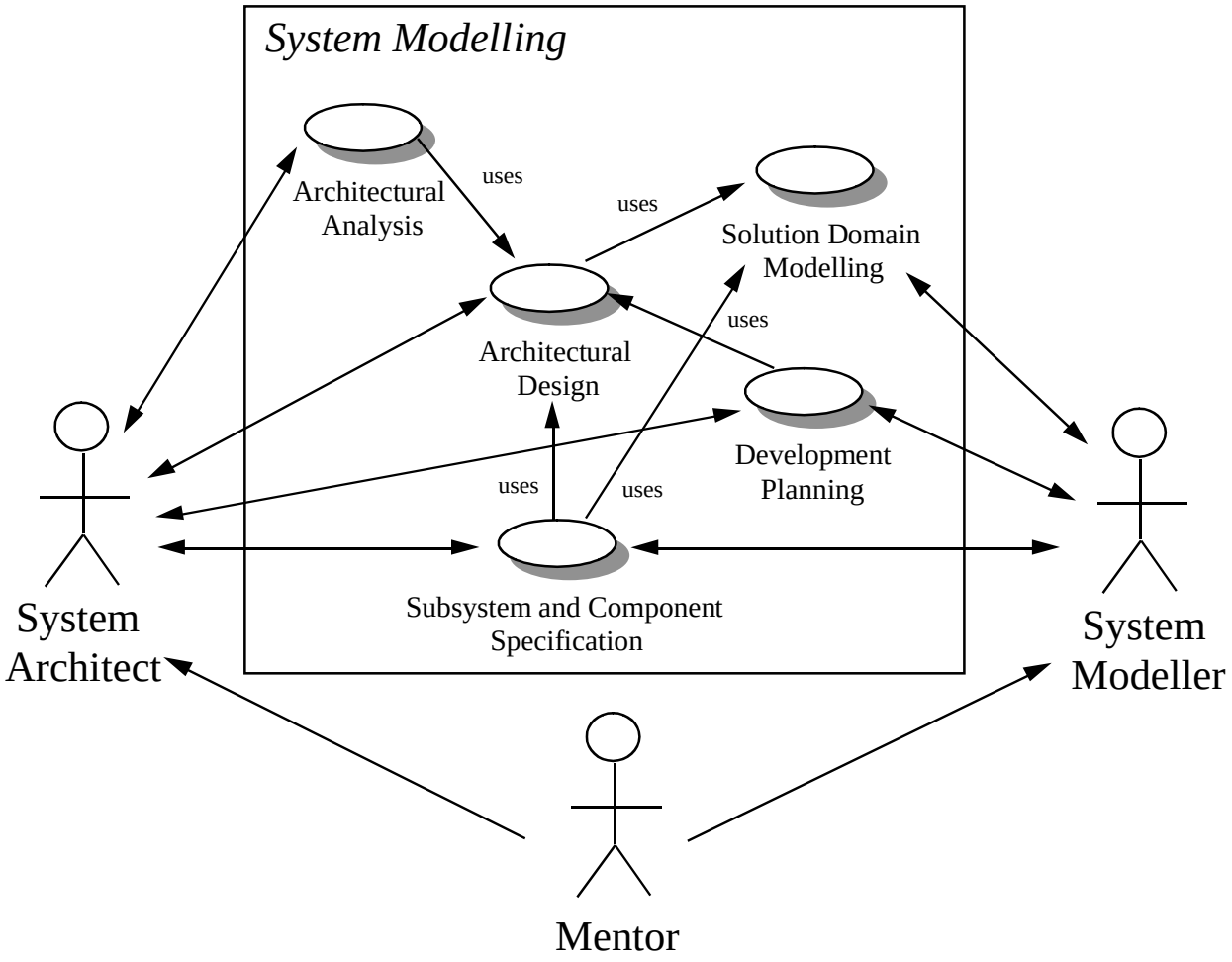
Mentor's Process Units

- **Acceptance Testing**
- **Alternatives Evaluation**
- **Component Modelling**
- **Concept Exploration**
- **Installation**
- **Programme Development**
- **Project Management**
- **Prototyping**
- **Quality Assurance**
- **Requirements Modelling**
- **System Modelling**
- **Subsystem Modelling**
- **Repository Design**
- **Post Deployment Review**
- **User Interface Modelling**

Processes, Activities,Tasks & Techniques



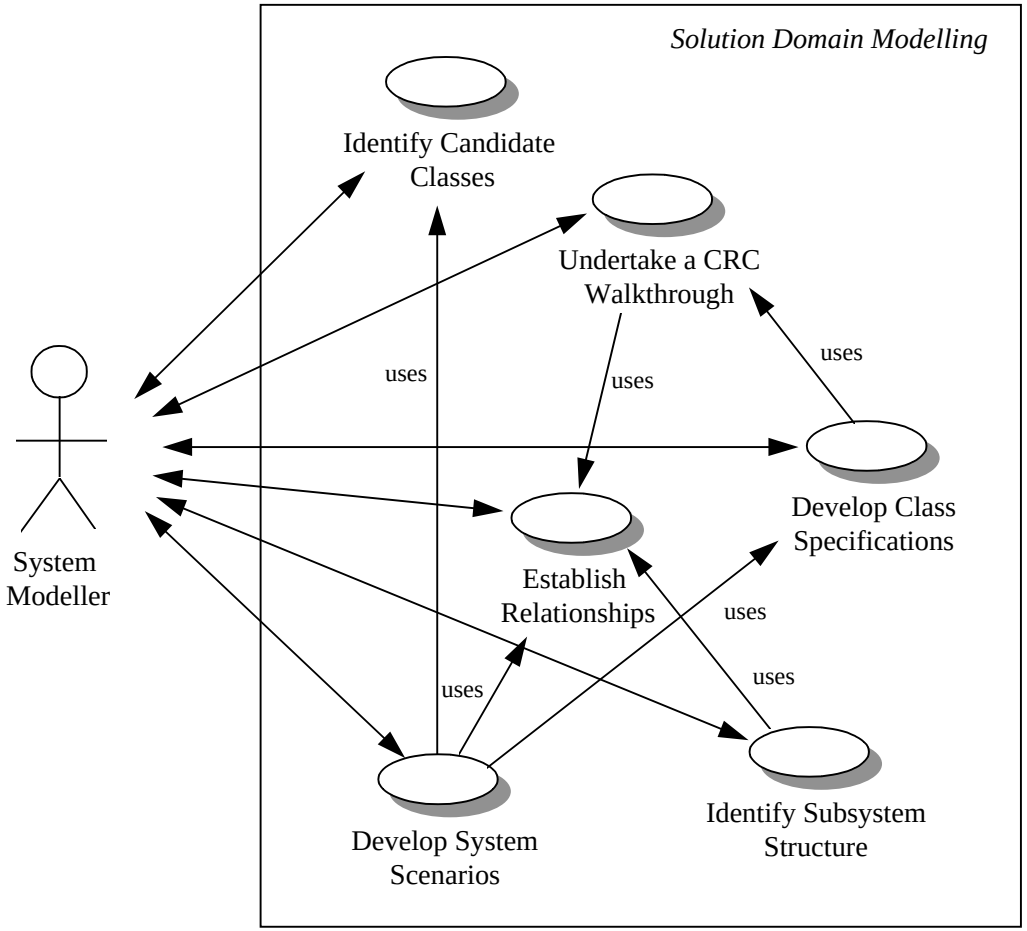
Process Units Have Activities



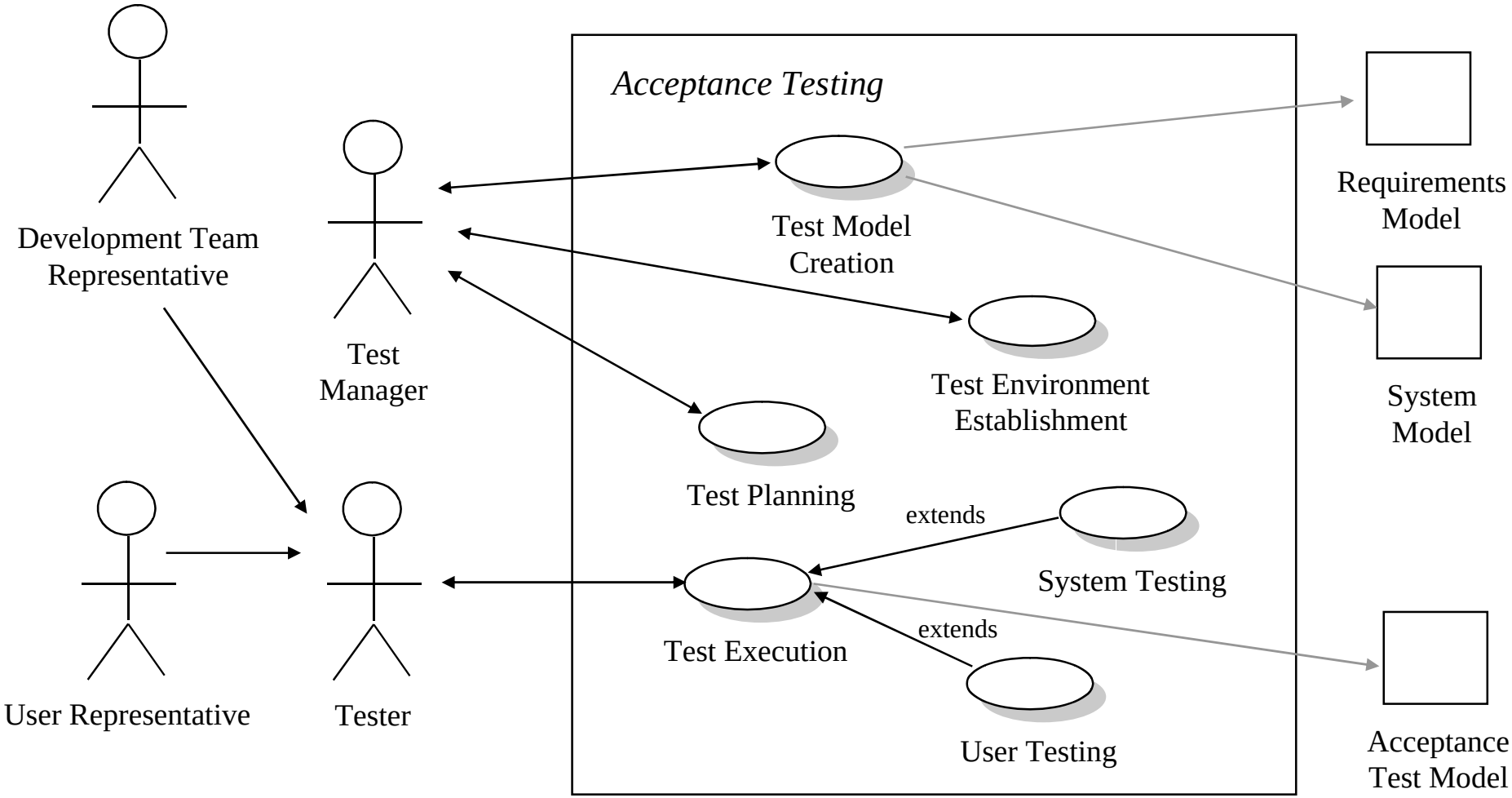
Activities

- **Each activity is defined in terms of a series of *tasks* which are the smallest unit of work subject to management accountability**
- **Tasks are accomplished by the use of "well-known" OOA&D techniques, such as:**
  - **scenario analysis**
  - **CRC carding**
  - **object and class modelling**
  - **and many more..**

Activities Have Tasks



Activities Produce Deliverables



Activities

- **Pre and post-conditions are part of the contract**
- **Deliverables and testing are part of post-condition**
- **Flexibility -- tailorable process**

Activities and Tasks

Tasks say what is to be done

For each activity/task combination we will recommend five levels of

probability from Always to Never

Examples of Tasks

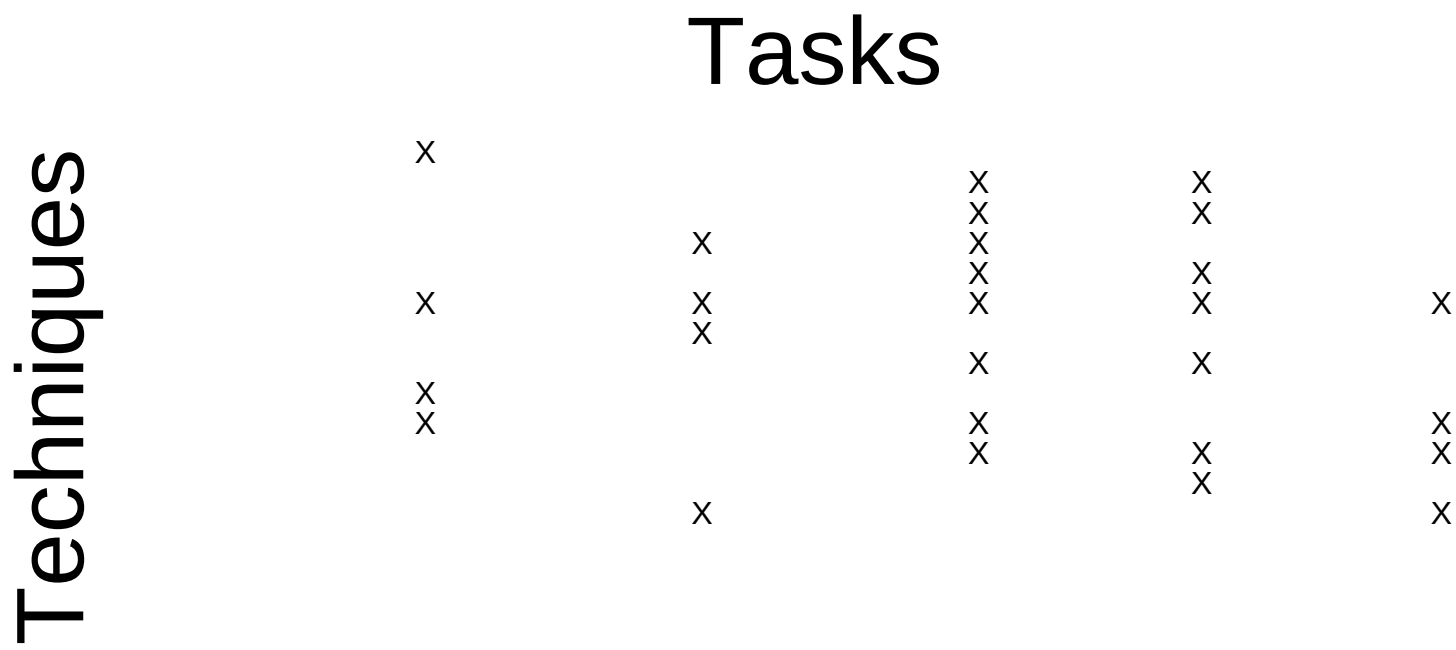
- **Create and/or identify reusable components**
- **Design and implement physical database**
- **Design user interface**
- **Develop and implement resource allocation plan**
- **Evaluate quality**
- **Identify user requirements**
- **Map roles onto classes**
- **Test**
- **Undertake feasibility study**
- **Write manual(s)**

BUT

- **Tasks say what is to be done in order to satisfy post-condition of each Activity; they do not say HOW the Task can be accomplished.**
- **This is the role of the technique. The developer chooses their own toolbox of techniques from the wide range (well over 150) provided -- part of the tailoring process**

Tasks and Techniques

Techniques suggest how it is to be done



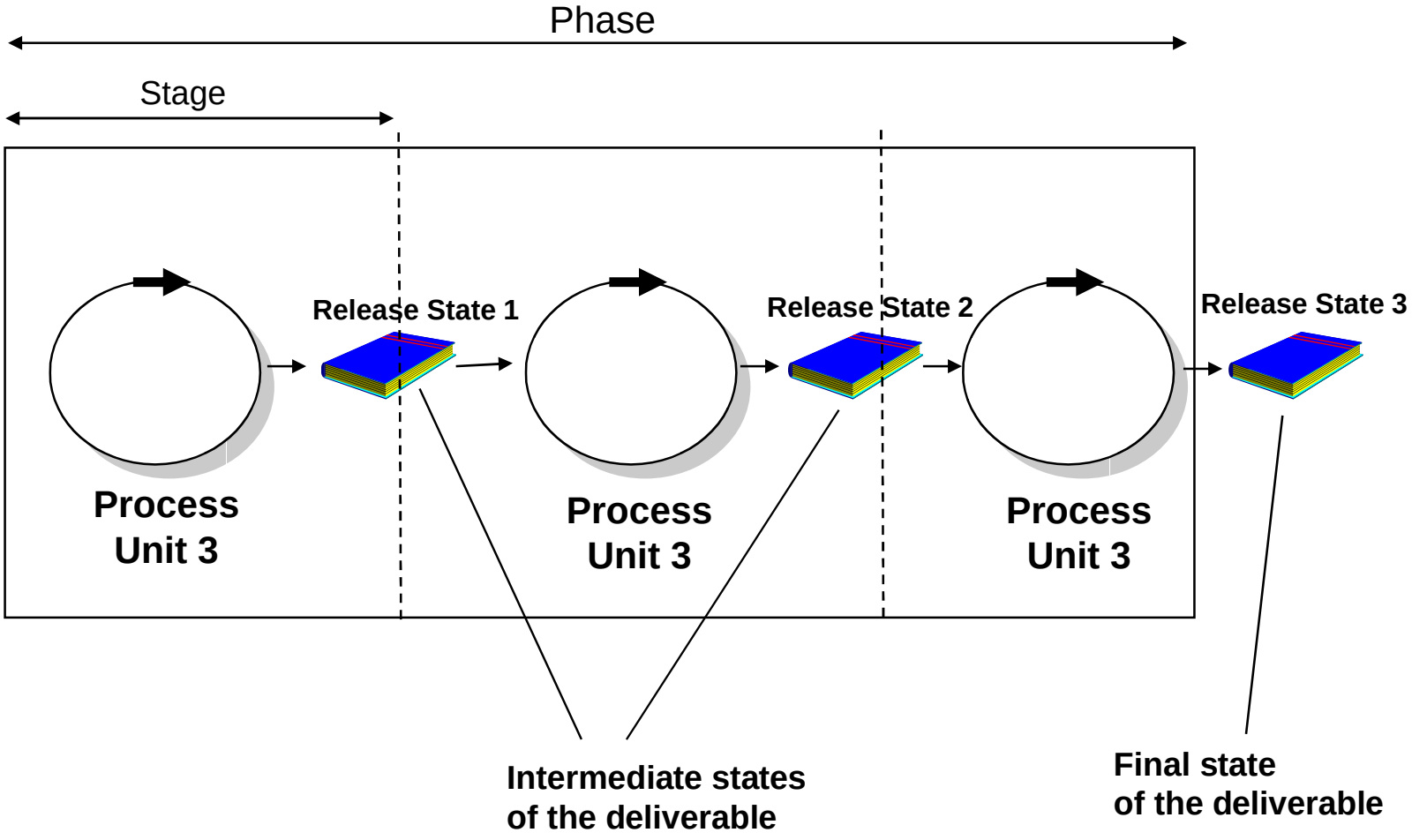
For each task/technique combination we will recommend five levels of

probability from Always to Never

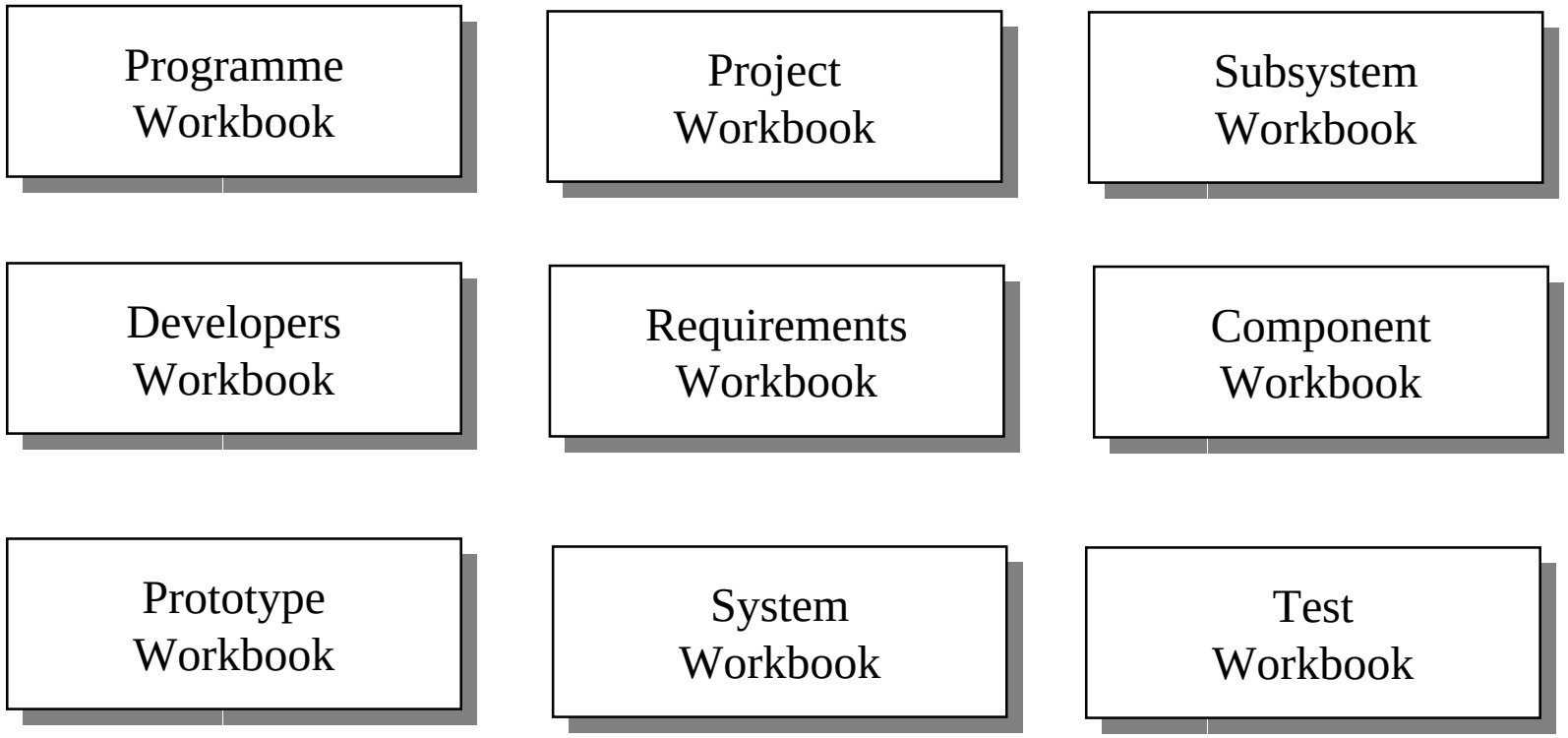
Examples of Techniques

- **Context modelling (BPR)**
- **DBMS selection**
- **DCS architecture specfn**
- **Hierarchical task analysis**
- **Metrics collection**
- **Power types**
- **Project planning**
- **Role modelling**
- **Rule modelling**
- **System event modelling**

Deliverables Have Release States



Mentor Deliverables are Housed in Workbooks



Workbooks & Deliverables Have Templates

Scenario:	Reply to a Message
Index Number:	BS002
Description:	Allows the user to reply to a message
Actors:	Mail User
Authors:	C. Brown
Preconditions:	None
Scenario Text:	1. Read Message 2. Create a reply **uses:** Compose a Message 3. Send the reply
Alternatives:	None
Extends:	None
Cross Validation:	None
Maturity Level:	Red
Questions/Notes:	Needs more detail
Modification:	First version 23/05/95

Scenario:	Compose a Message
Index Number:	BS003
Description:	Allows the user to create a message
Actors:	Mail User
Authors:	C. Brown
Preconditions:	None
Scenario Text:	1. Record the response 2. Indicate that the response has been recorded
Alternatives:	None
Extends:	None
Cross Validation:	None
Maturity Level:	Red
Questions/Notes:	Needs more detail
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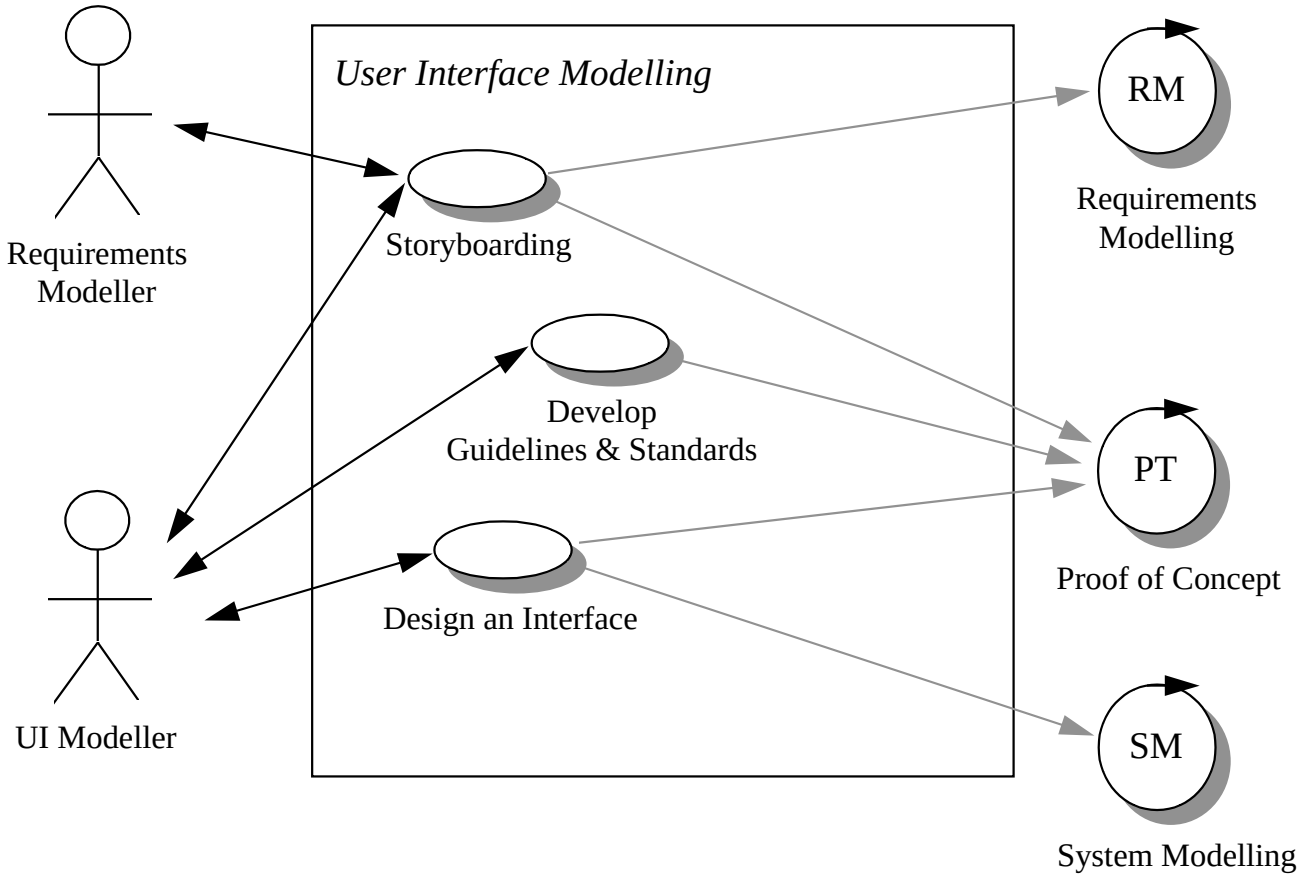
Processes are Interactive



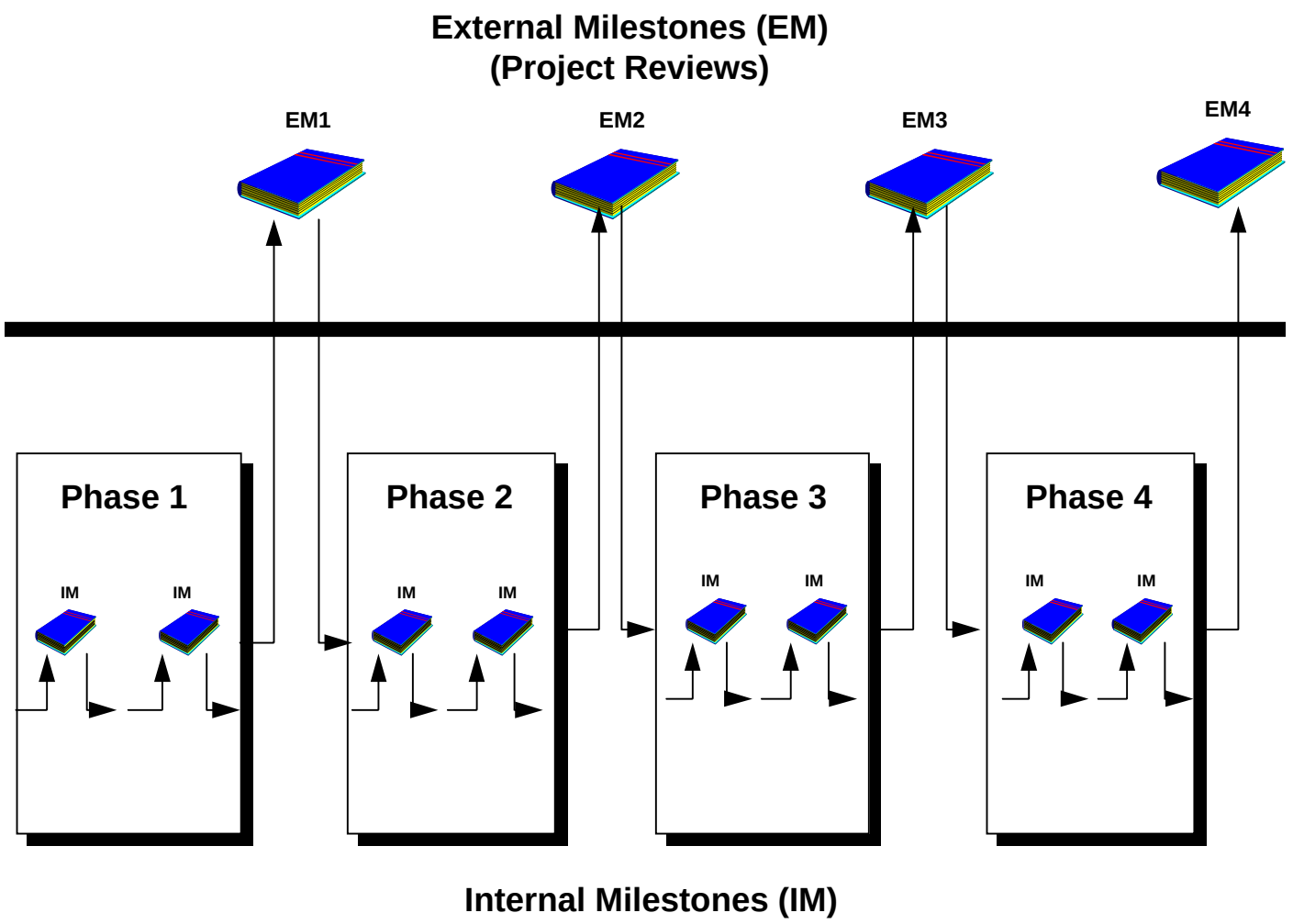
Software Lifecycle Models

- **Are a *framework* that specifies the way in which a project may be run**
- **Are a general description, or template for software projects**
- **Provides structure to the Software Engineering Process through:**
  - **Phases**
  - **Stages**
  - **Milestones - internal and external**

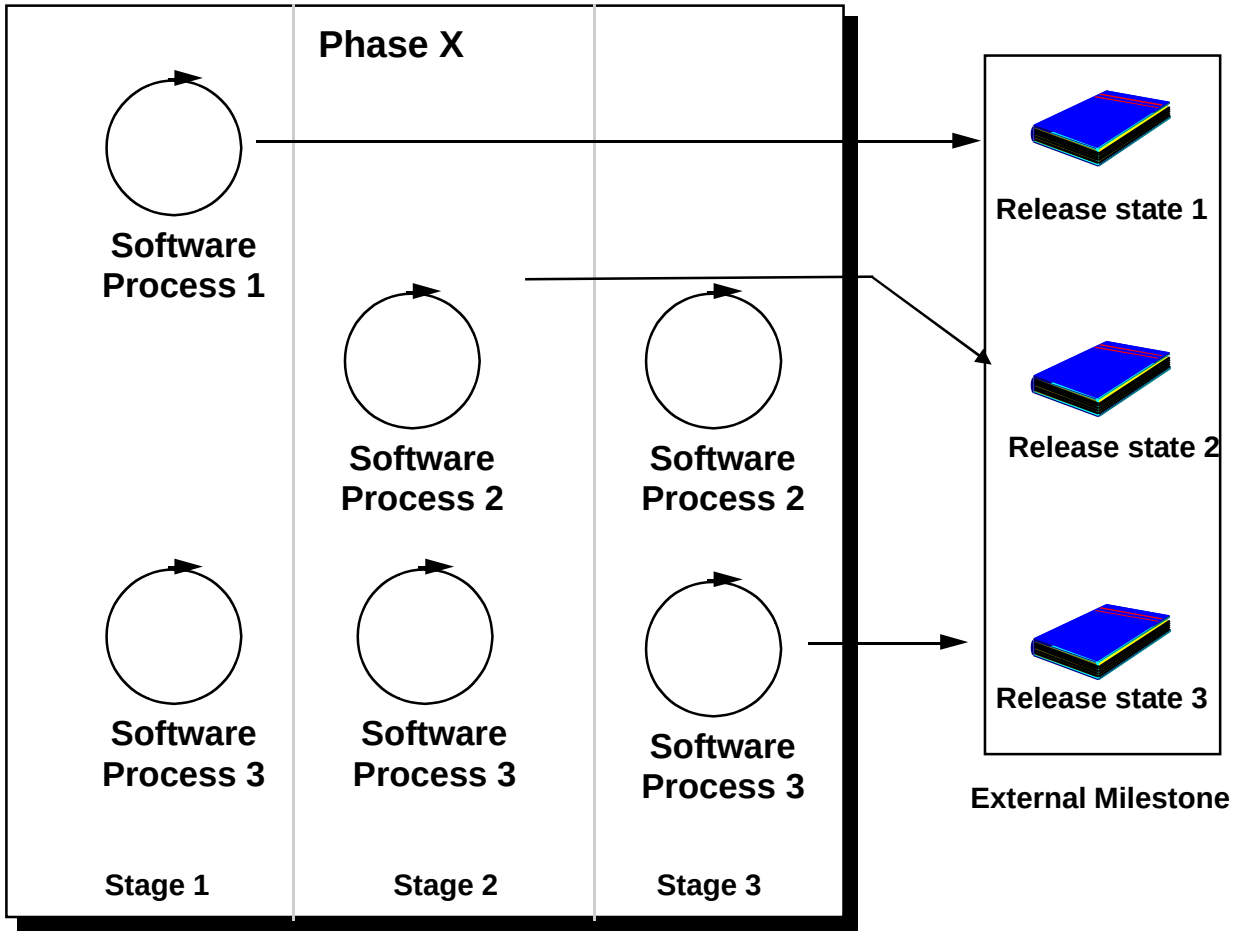
Software Lifecycle Model

- **Examples include:**
  - **Waterfall**
  - **Iterative**
  - **Incremental**
  - **Incremental/Iterative**
  - **Spiral**
  - **Fountain**

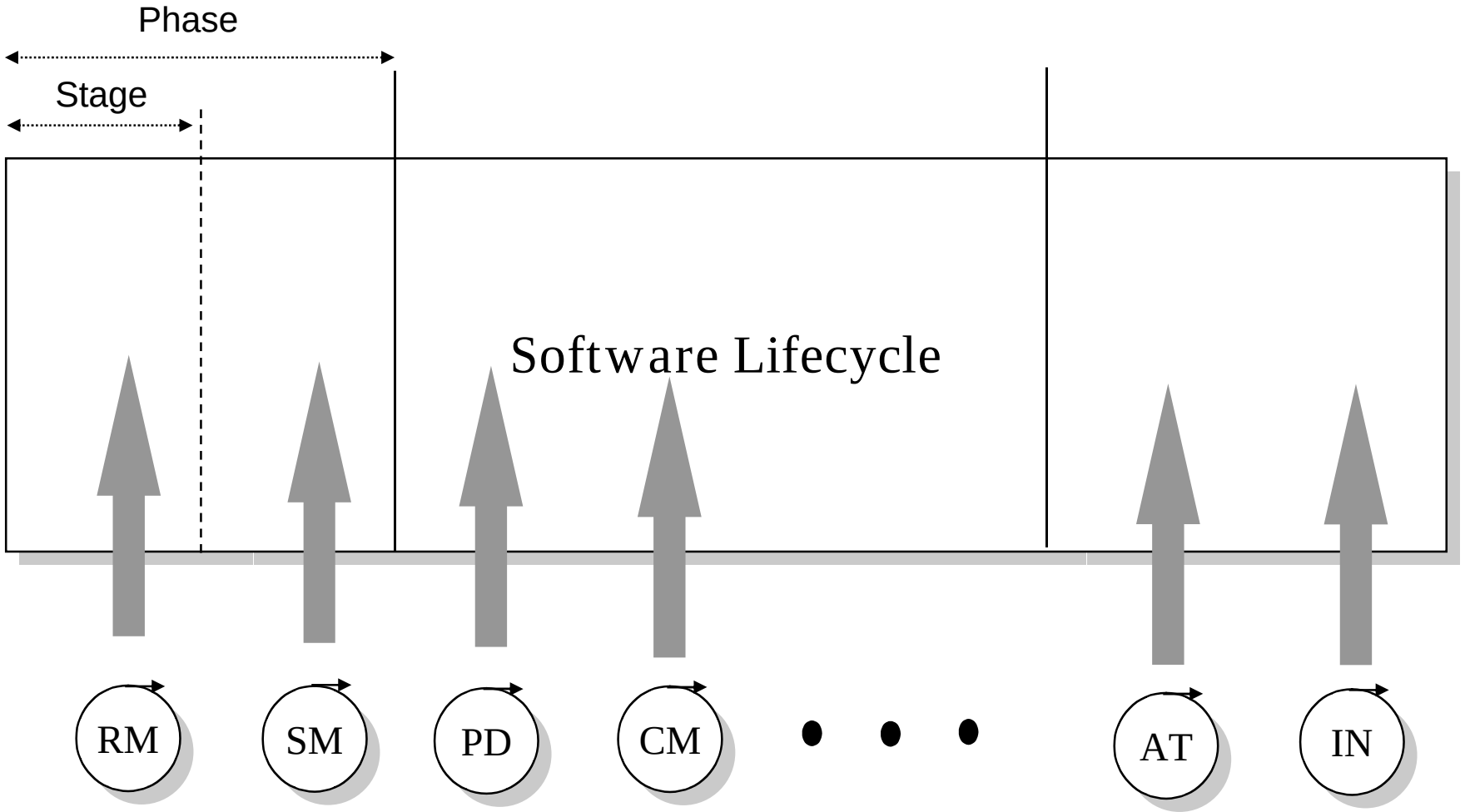
Phases and Milestones



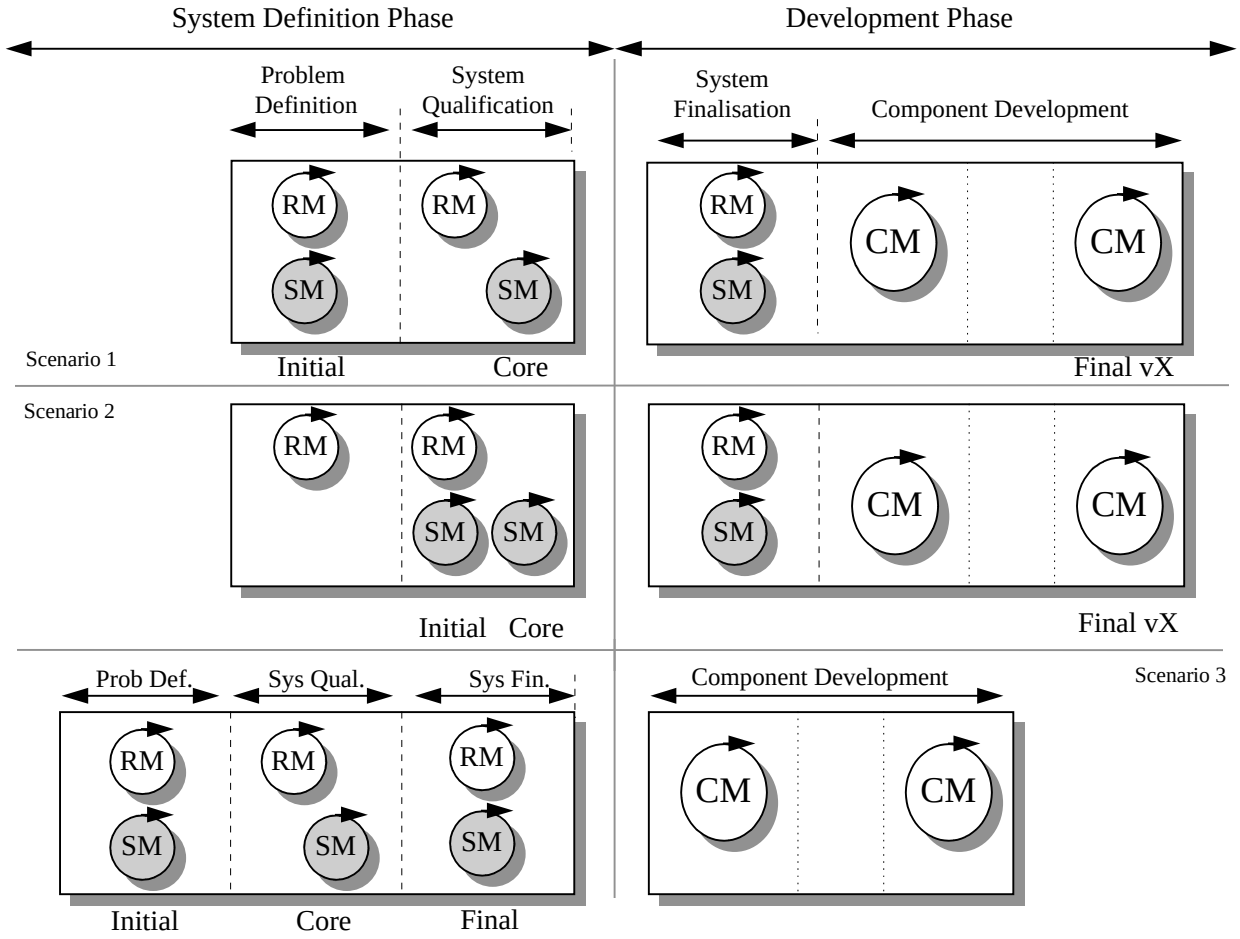
Phases, Stages and Processes



Constructing a Software Engineering Process



Processes Support Many Configurations



OPEN and MeNtOR's Software Engineering Process Architecture

- **=Methodology**
- **Ability to develop additional SEPs optimal for individual project types**
- **Provides an organisation with *flexibility* and *consistency***

Overview

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Summary

- ***OPEN and MeNtOR* provide**
  - **a *complete* and *disciplined* process for object-oriented software engineering**
  - ***consistency* with *flexibility***
  - **Promotes *Engineering of the Software Process***

OPEN Support

- **Books and papers (precursor methods):**
  - **OPEN/MOSES: BOOKTWO of Object-Oriented Knowledge: The Working Object (B. Henderson-Sellers & J.M. Edwards), Prentice Hall, 1994**
  - **OPEN/SOMA:Migrating to Object Technology (I.M. Graham), Addison Wesley, 1995**
  - **OPEN/Firesmith: Object-Oriented Requirements Engineering and Logical Design, Wiley, 1993**

OPEN Support

- **Books and papers:**
  - **OPEN: towards method convergence?, IEEE Computer, April 1996, 29(4), 86-89**
  - **The OPEN-MeNtOR methodology, Object Magazine, Nov 1996, 6(9), 56-59**
  - **OPEN project management, ObjectExpert, Jan/Feb 1997, 2(2), 30-35**
  - **OPEN Modelling Language (OML) Reference Manual, SIGS Books, March 1997, 271pp**
  - **The OPEN Process Specification, Addison-Wesley, July 1997, in press**
  - **OPEN's Toolbox of Techniques, Addison-Wesley, September 1997 (approx).**

OPEN Support

- **CASE tools**
  - **ObjectMaker, Simply Objects, SOMATiK plus (likely soon) MetaEdit, Graphical Designer, LBMS, Paradigm Plus**
- **Training worldwide from several third-party companies e.g.**
  - **Tower, KSC, Thomsen Due, FourFront, COTAR Vayda, OIG, Genesis**

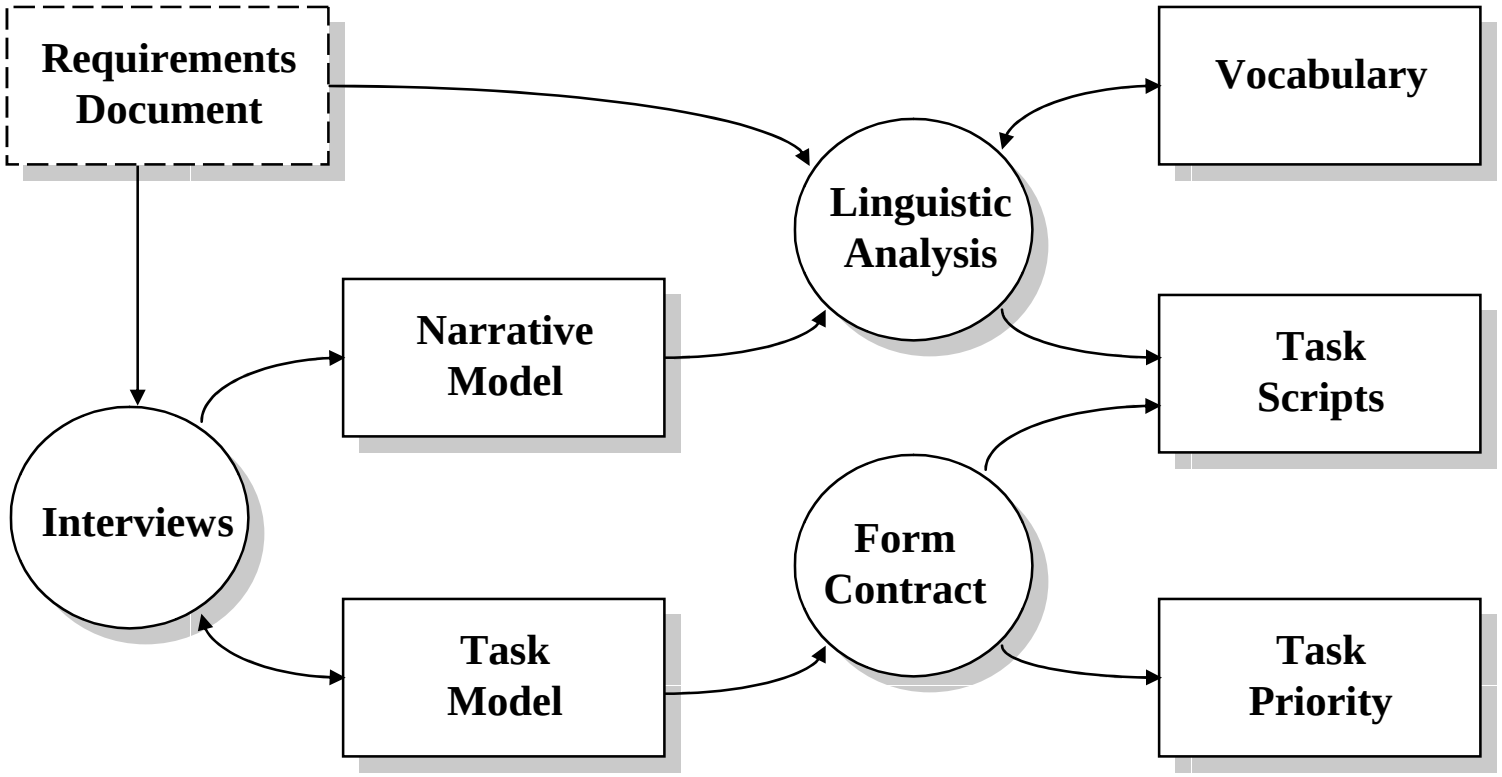
MeNtOR Support

- **Object Oriented Pty Ltd**
  - **Formal Training**
  - **Workshops**
  - **Process and Design Consulting**
  - **Online Manuals & Templates**
- **CASE tools**
  - **LBMS, StP, Simply Objects**
  - **Paradigm Plus, Object Team ...**

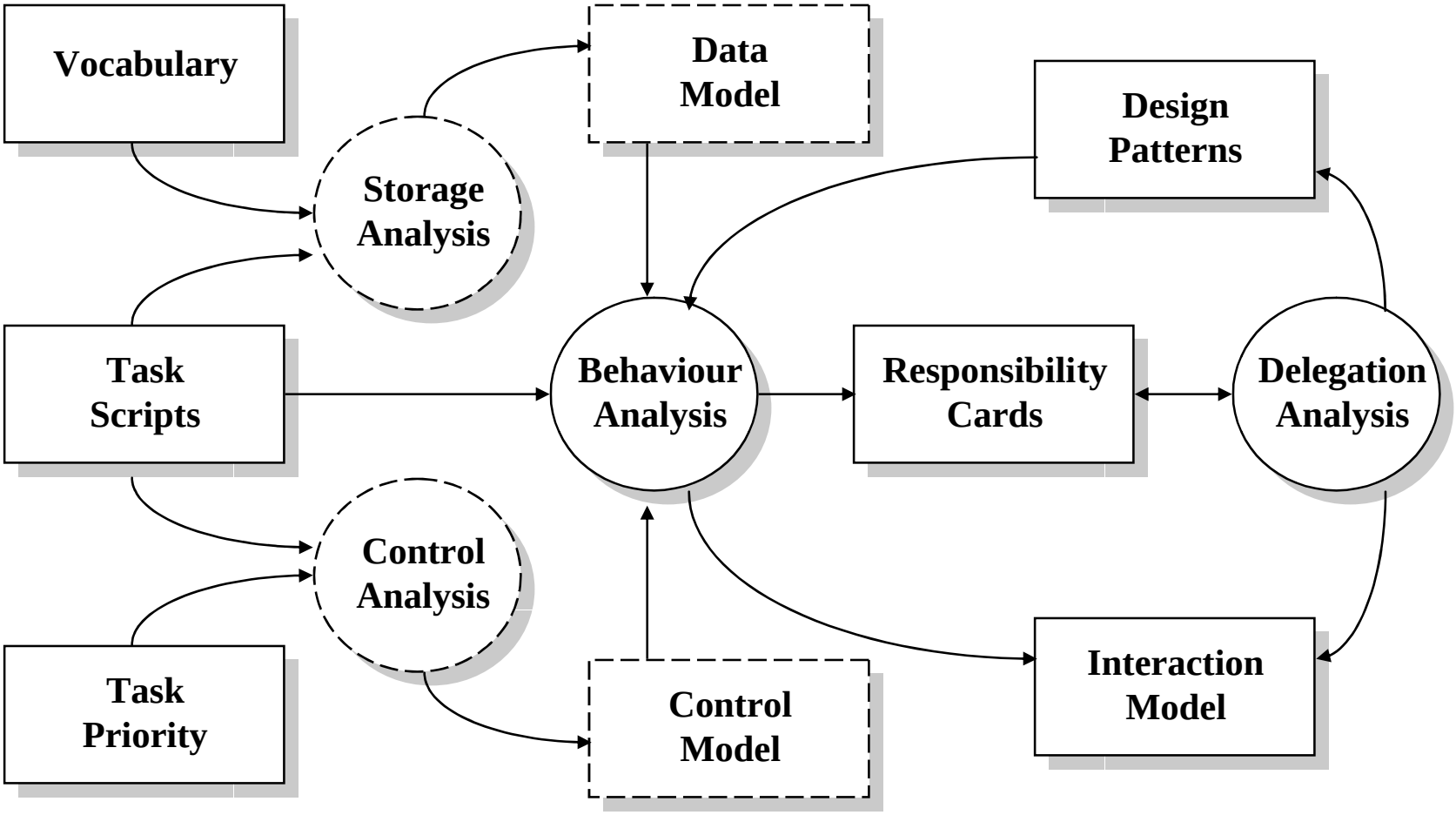
“Open” Research Issues

- **Incorporation of Formal techniques (Object Z/FOOM) [Swinburne and UQ]**
- **Screen layout algorithms [Newcastle University]**
- **Reverse engineering [Monash University]**
- **Empirical testing [Dow Jones Telerate]**
- **Requirements Engineering [Discovery/Simons UK, IDIS/Winder UK]**

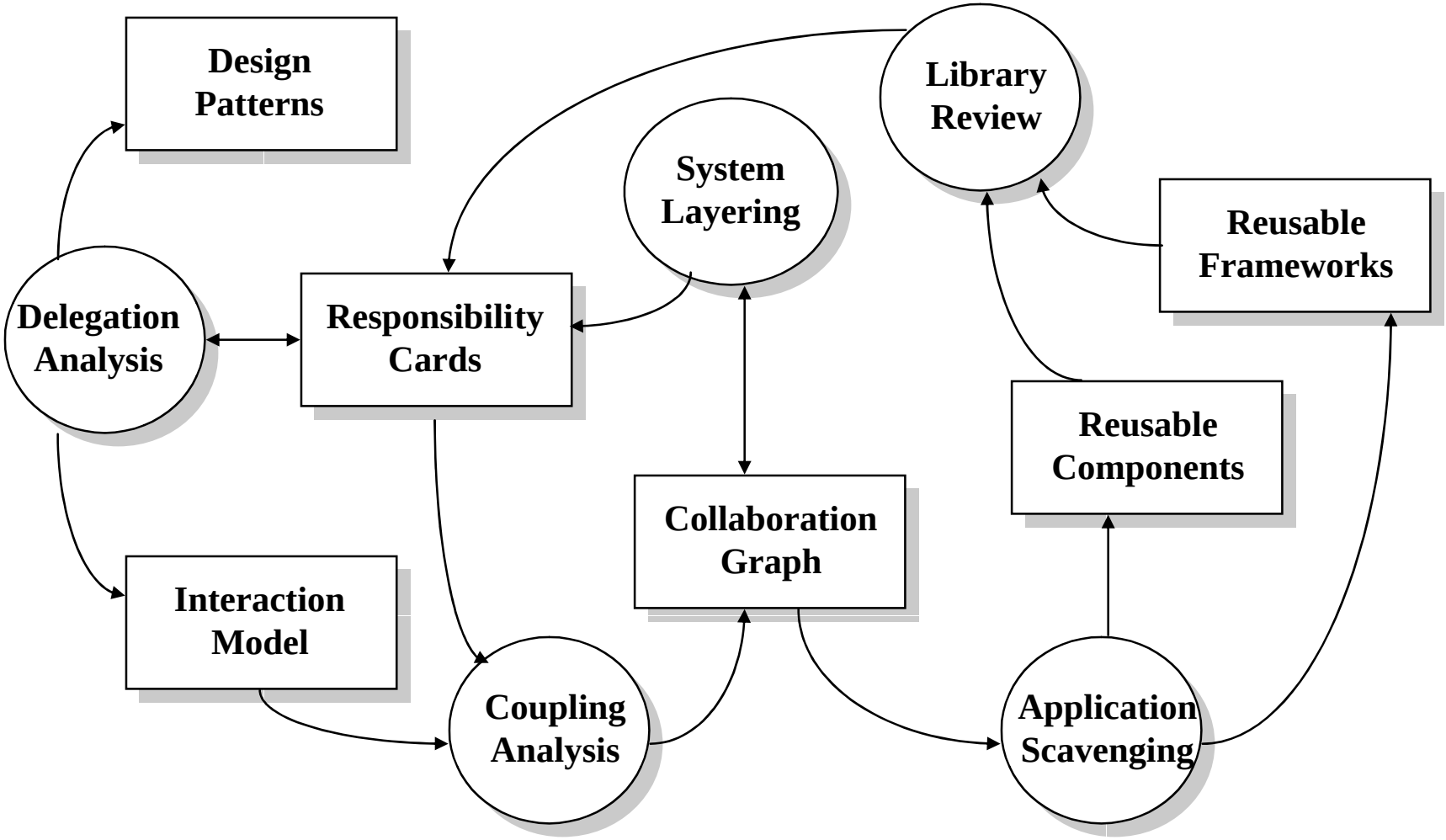
Discovery: Task Modelling



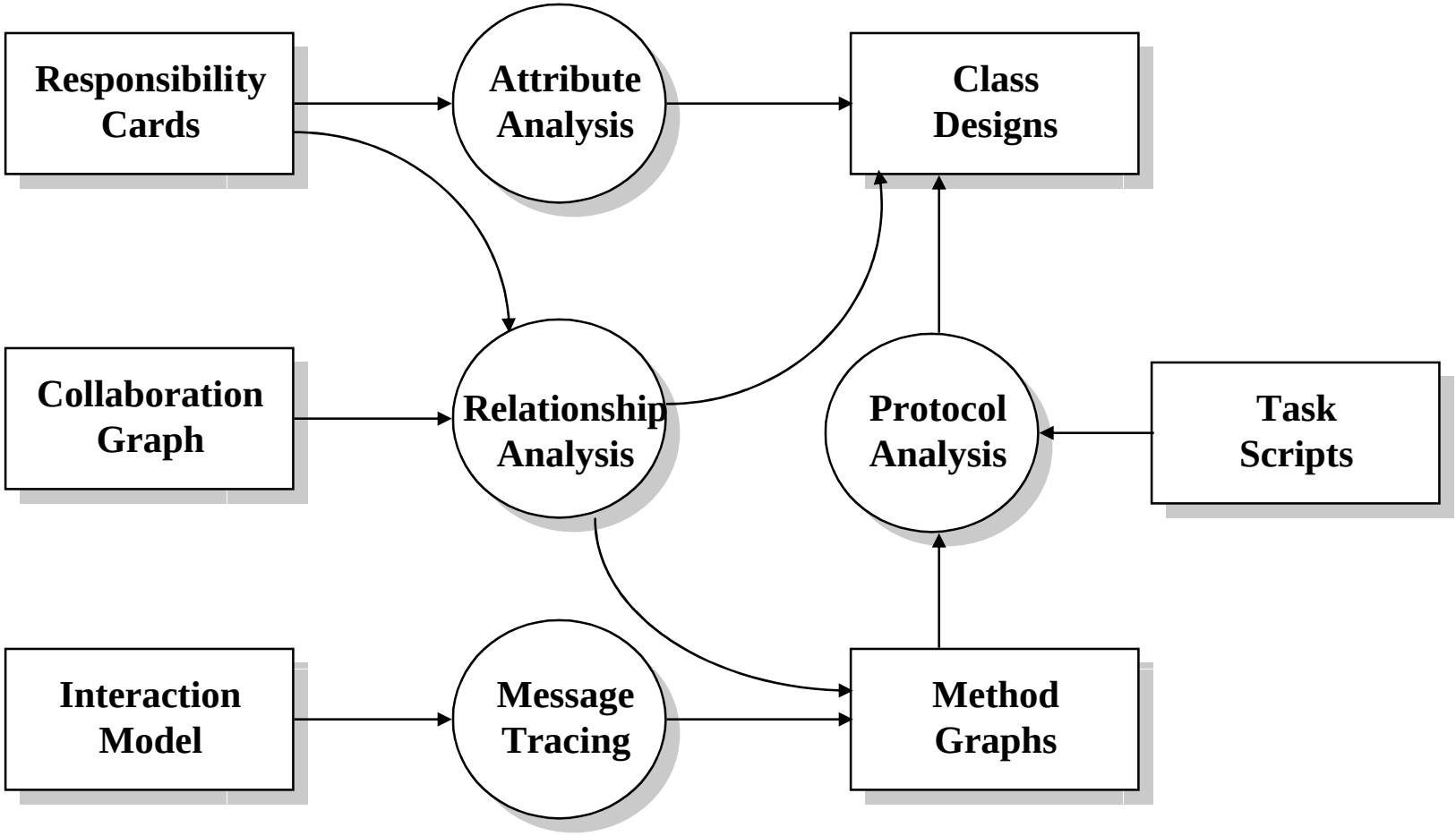
Discovery: Object Modelling



Discovery: System Modelling



Discovery: Language Modelling



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Deployment Process

- **The deployment of an OO method involves a number of phases and should be treated as any other managed project**
- **Phases include:**
  - **Selection**
  - **Project Establishment**
  - **Project Driving**
  - **Review and Improvement**

Selection Phase

- **Review the process:**
  - **Identifying if it is a *Technique*, *Method* or *Process***
  - **Exploring the coverage of the *concepts***
  - **Exploring the form of *representation* supported**
  - **Exploring the coverage of the *lifecycle* requirements**
  - **Identifying how it deals with *pragmatic aspects* of undertaking projects**
  - **Identifying the *CASE tools* supported**
  - **Identifying the *languages* supported**

Selection Phase (cont)

- **Review:**
  - **The availability of *training* services**
  - **The availability of *mentoring* services**
  - **The *CMM level* for which you wish to be certified (Processes and Methodologies only)**
  - **The requirements of the *Quality Management System* that you currently have in place**

Project Establishment Phase

- **The Project Establishment phase is where the initial setting up and planning occurs**
- **Activities of the phase include:**
  - **Install the process material**
  - **Undertake project planning sessions**
    - **Define SEP**
    - **Undertake an initial tailoring/integration**
  - **Formal Training**
    - **1-3 weeks**
    - **concepts, languages, processes**
  - **Process automation**
    - **tool selection**
    - **tool integration**

Project Establishment Phase (cont)

- **Identify a Software Process Group or Core Team**
  - **“Own and maintain the method”**
  - **Act as mentors to future team members**
  - **Be committed to process improvement**
- **Train and mentor this team on:**
  - **object oriented techniques**
  - **process improvement techniques**

Project Driving Phase

- **The Project Driving phase is where the project proper starts and the team applies the process**
- **Activities of the phase include:**
  - **Mentoring**
  - **Workshops**
  - **Process Refinement**
  - **Reviews**
- **Ensure correct application of process**

Review and Improvement Phase

- **The Review and Improvement phase is where the project is reviewed regularly to ensure the process is being applied and to document any improvements**
- **Activities**
  - **Project Reviews**
    - **Assisting with the “finer points” of process**
  - **Process Audits**
    - **Reports on the application of the process and areas for improvements and refinement**
  - **Post Project Review**
    - **Lessons learnt and recommendations made**

Some Key Lessons Learnt

- ***Successful* Process Deployment Requires:**
  - **Consistent Application**
  - **A Pragmatic Approach**
  - **Proactive Management**
  - **One Message**
  - **Visible Results and Feedback Loops**
  - **Strong Leadership Based on Experience**
  - **A Desire to Change**
  - **Medium Term Investment Horizon**

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Summary

- **Hope to have provided you with**
  - **An overview of where OO methods have come from and where they are going**
  - **An overview of the OPEN/MeNtOR object oriented process architecture**
  - **A possible deployment strategy for process in your organisation**
- **Process is a critical element for effective software engineering - software engineering with object technology demands an investment in an OO software process**

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