2008 Fall

Software Modeling & Analysis

OSP Summary

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What is OSP?

- OSP (Object Space Process)
  - A software process based on RUP
  - Tailored to SE classes in universities

- Characteristics of OSP
  1. 3 Stages
  2. Iterative : Multiple development cycles
  3. Incremental : System grows incrementally as each cycle is completed
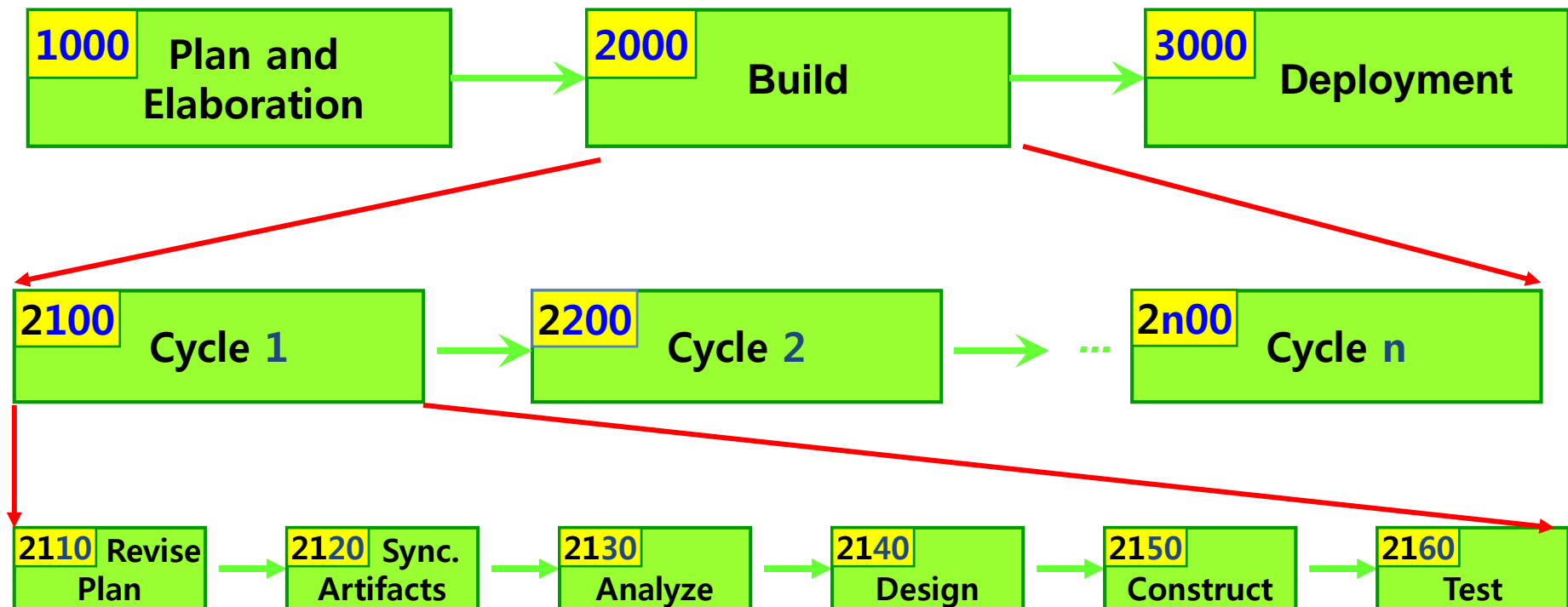 4. Architecture : Stage > Cycle > Phase > Activity

| 1000 Plan and Elaboration | → | 2000 Build | → | 3000 Deployment |

1. 3 Stages

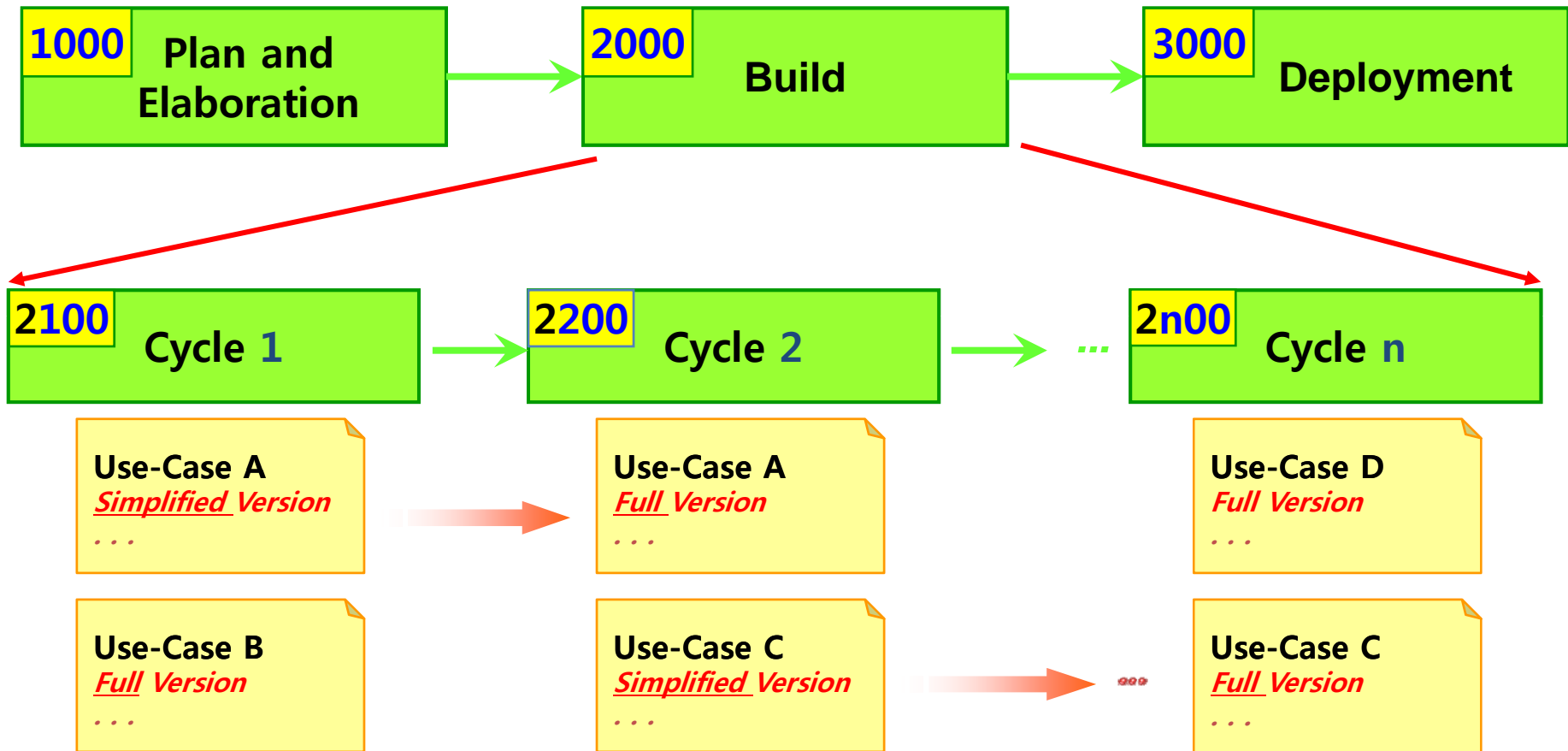| 1000 Plan and Elaboration	→	2000 Build	→	3000 Deployment

- Stage 1000 : Plan and Elaboration
  - Planning, defining requirements, building prototyping, etc
  - Corresponding to Inception/Elaboration phases in the RUP
- Stage 2000 : Build
  - Construction of the system
  - Corresponding to Construct phase in the RUP
- Stage 3000 : Deployment
  - Implementation of the system into use
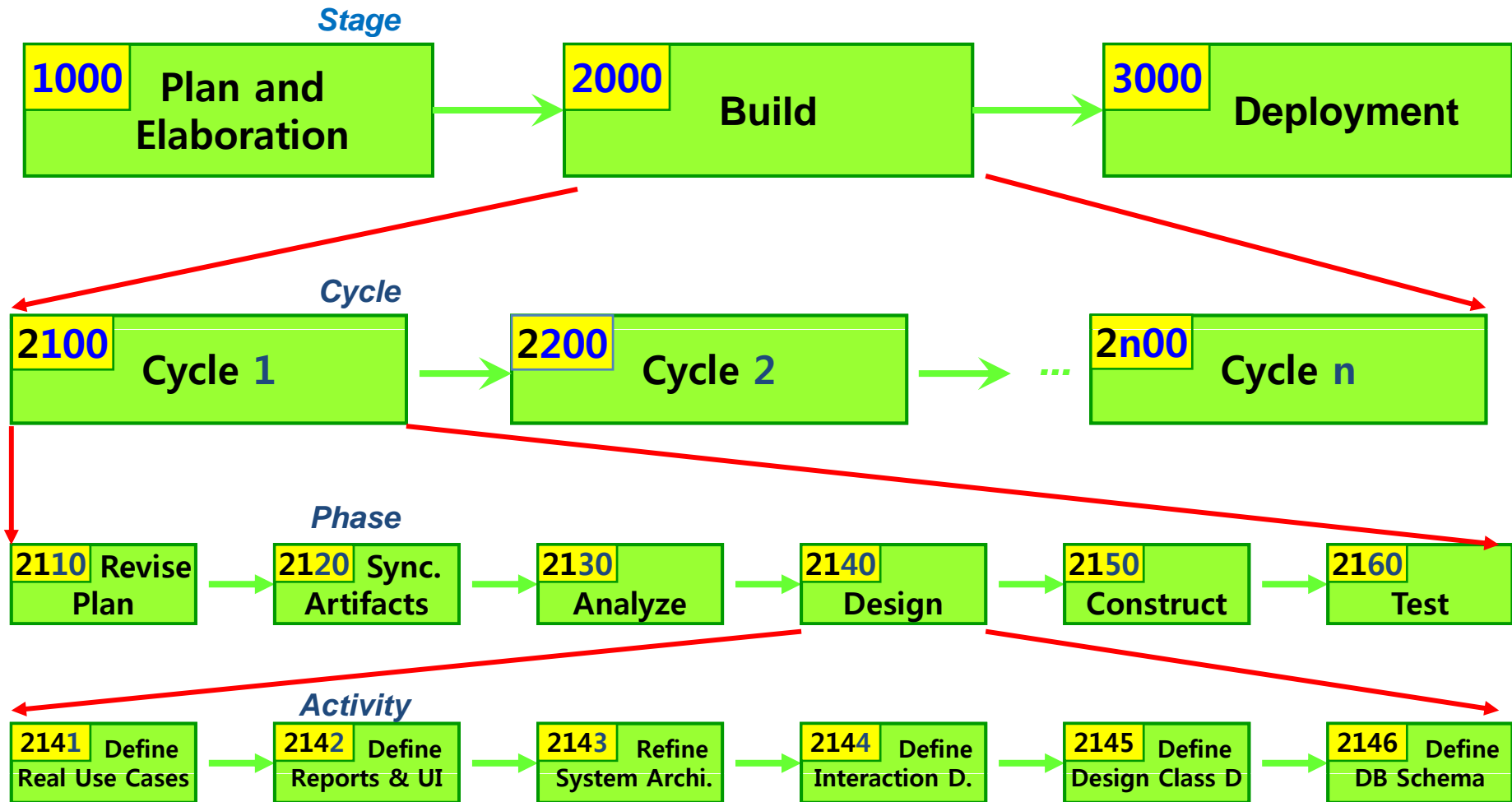 - Corresponding to Transition phase in the RUP

2. Iterative Development

- Multiple iterations in the Build stage
- Each iteration took about 2 to 8 weeks

| **1000** Plan and Elaboration | → | **2000** Build | → | **3000** Deployment |

| **2100** Cycle 1 | → | **2200** Cycle 2 | → ... → | **2n00** Cycle n |

| **2110** Revise Plan | → | **2120** Sync. Artifacts | → | **2130** Analyze | → | **2140** Design | → | **2150** Construct | → | **2160** Test |

3. Incremental Development

1000 **Plan and Elaboration**	→	2000 **Build**	→	3000 **Deployment**

2100 **Cycle 1**	→	2200 **Cycle 2**	→ ...	2n00 **Cycle n**

Use-Case A
Simplified Version
. . .
→
Use-Case A
Full Version
. . .

Use-Case D
Full Version
. . .

Use-Case B
Full Version
. . .

Use-Case C
Simplified Version
. . .
→ ...
Use-Case C
Full Version
. . .

4. Architecture of OSP

Stage

| 1000 Plan and Elaboration | → | 2000 Build | → | 3000 Deployment |

Cycle

| 2100 Cycle 1 | → | 2200 Cycle 2 | → ... | 2n00 Cycle n |

Phase

| 2110 Revise Plan | → | 2120 Sync. Artifacts | → | 2130 Analyze | → | 2140 Design | → | 2150 Construct | → | 2160 Test |

Activity

| 2141 Define Real Use Cases | → | 2142 Define Reports & UI | → | 2143 Refine System Archi. | → | 2144 Define Interaction D. | → | 2145 Define Design Class D | → | 2146 Define DB Schema |

Stage 1000.
Plan and Elaboration

| 1000 Plan and Elaboration | → | 2000 Build | → | 3000 Deployment |

Stage 1000. Plan and Elaboration

- Stage 1000 Activities

| a. ongoing |
| b. optional |
| c. may defer |
| d. varied order |

| 1000 | Plan and Elaboration |

| 1001 | Define Draft Plan | 1002 | Create Preliminary Investigation Report | 1003 | Define Requirements |

| 1004 | Record Terms in Glossary a | 1005 | Implement Prototype b,d | 1006 | Define Business Use Case |

| 1007 | Define Business Concept Model | 1008 | Define Draft System Architecture a,c,d | 1009 | Refine Plan |
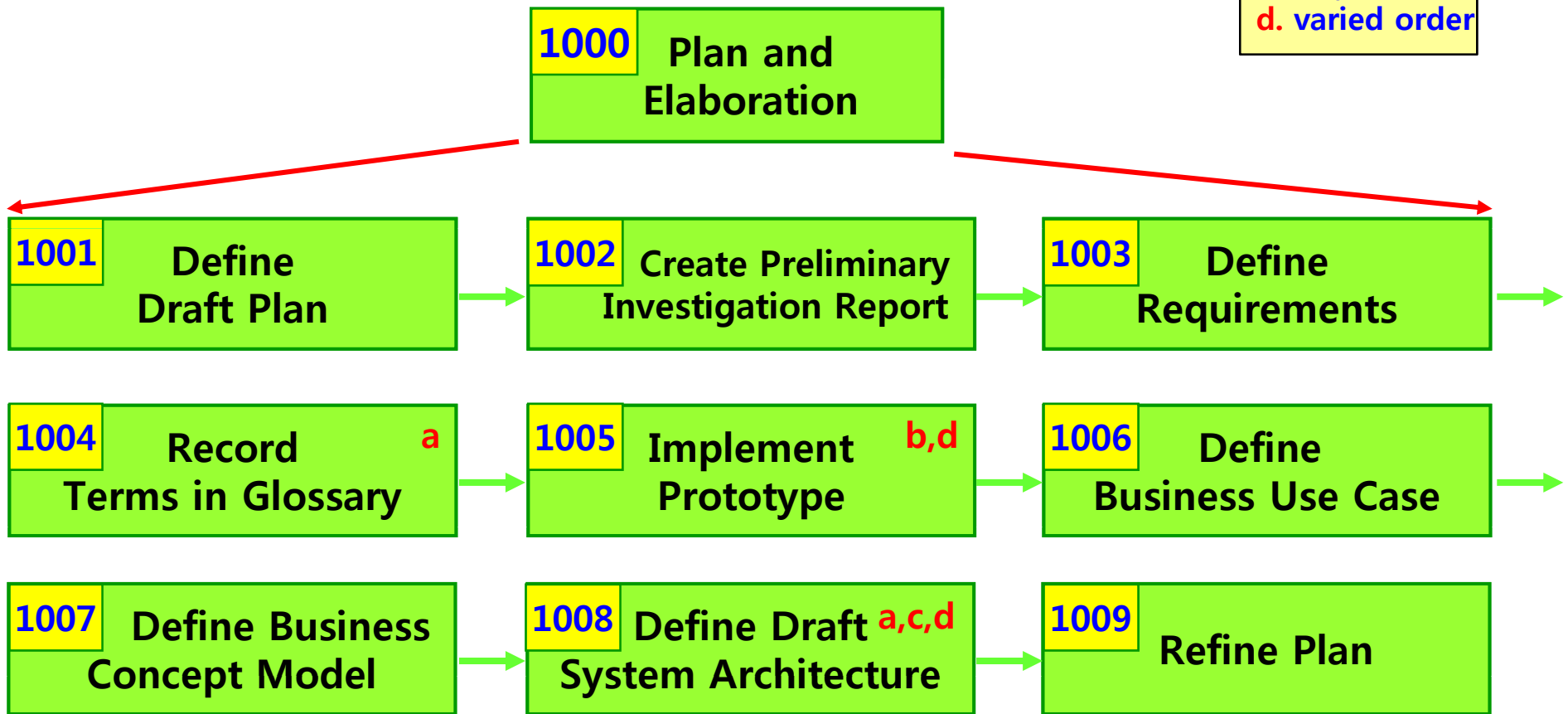
Activity 1001. Define Draft Plan
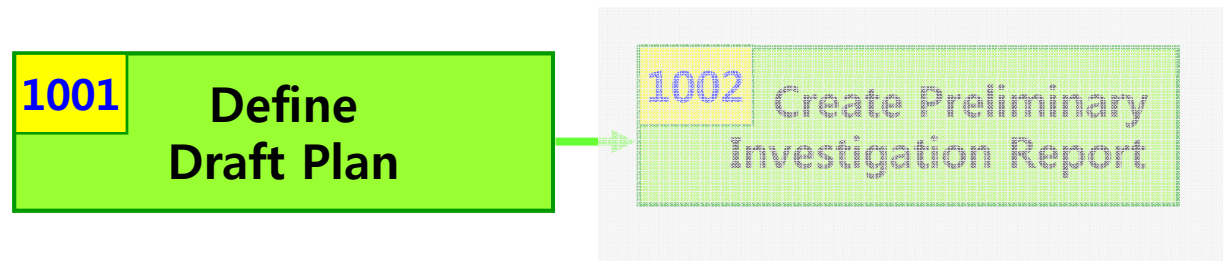
- Description
  - Write a draft plan for schedule, resources, budget, objective, etc
  - Input : related documents of previous similar projects
  - Output : a draft project plan
- Steps
  1. Write motivation and objective of project
  2. Write scope of project
  3. Identify and write functional requirements
  4. Identify and write non-functional requirements
 5. Estimate resources (human efforts(M/M), human resources, duration, budget)

Activity 1002.
Create Preliminary Investigation Report

| 1001 Define Draft Plan | → | **1002 Create Preliminary Investigation Report** | → | 1003 Define Requirements |

- Description
  - Write an investigation report on alternatives, business needs, risk, etc
  - Input : draft project plan
  - Output : an investigation report

- Steps
  1. Write alternative solutions
  2. Write project's justification (business needs)
  3. Identify and manage risks, and write risk reduction plans
  4. Analyze business market
  5. Write managerial issues

Activity 1003. Define Requirements

1002 Create Preliminary Investigation Report	1003 **Define Requirements**	1004 Record Terms in Glossary
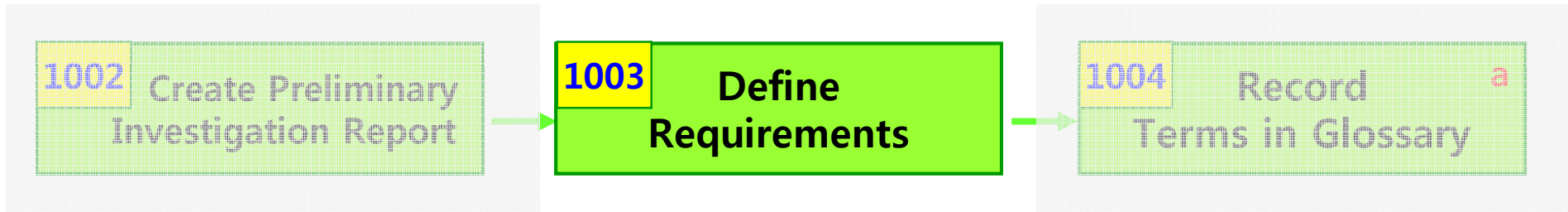
- Description
  - Write a requirement specification for a product
  - Input : draft project plan, investigation report
  - Output : a requirement specification

- Functional requirements
- Non-functional requirements

- Recommended reference : IEEE Std. 830-1998

Activity 1004. Record Terms in Glossary

1003 Define Requirements	1004 **Record Terms in Glossary** a	1005 Implement Prototype b,d

- Description
  - Similar to "Data Dictionary"
  - Dictionary of terms and any associated information(constraints and rules)
  - Input : requirements specification
  - Output : a term dictionary
- Steps
  1. Describe meaning of terms specified in requirements specification
 2. Write alias of each term

Activity 1005. Implement Prototype

1004 Record Terms in Glossary a	→	1005 **Implement Prototype** b,d	→	1006 Define Business Use Case
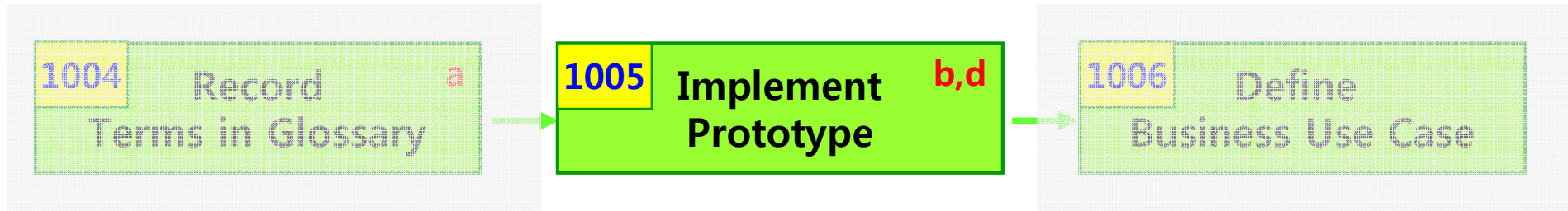
- Description
  - Develop a prototype system to permit use feedback, determine feasibility, or investigate timing or other issues
  - Input : requirements specification
  - Output : a prototype
- Steps
  1. Develop a prototype

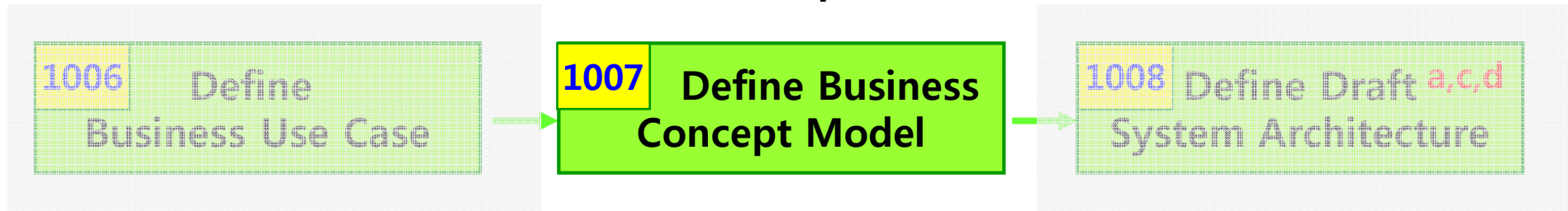# Activity 1006. Define Business Use Case

1005 Implement Prototype b,d	1006 Define Business Use Case	1007 Define Business Concept Model

- Description
  - To obtain a deeper understanding of the processes and requirements identified so far
  - Identify business tasks as business use cases, and illustrate their relationships in use case diagrams
  - Input : requirements specification
  - Output : a business use case model (High-level use case)
    - Business Use Case Diagram
    - Business Use Case Description

POST

Cashier

Buy Items

Log In

Refund Items

Customer
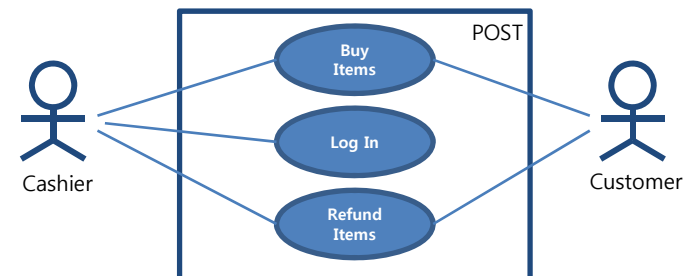
Activity 1007.
Define Business Concept Model

1006 Define Business Use Case	→	1007 **Define Business Concept Model**	→	1008 Define Draft System Architecture a,c,d

- Description
  - Identify "business concept" in the target domain which can be candidates for "classes"
  - Input : requirements specification
    term dictionary
    business use case model
  - Output : a business concept model

- Steps
  1. Identify business terms or business concepts from requirements specification or through interviews with domain experts
  2. Define identified terms as business concepts
     - Implementation details can't be business concepts
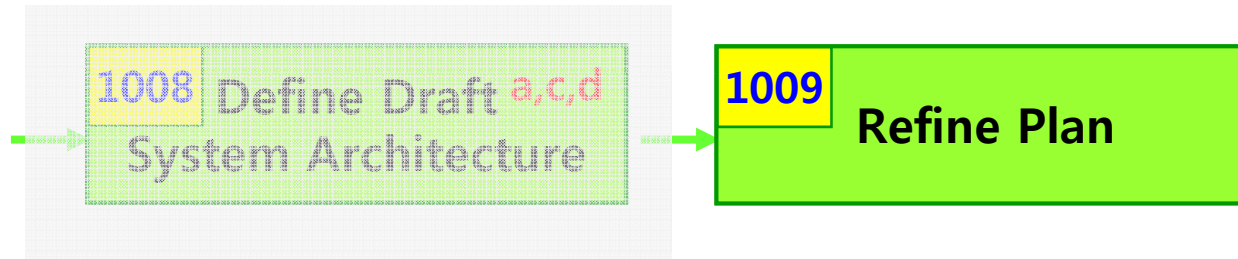
Activity 1008.
Define Draft System Architecture

| 1007 Define Business Concept Model | 1008 **Define Draft** **a,c,d** **System Architecture** | 1009 Refine Plan |
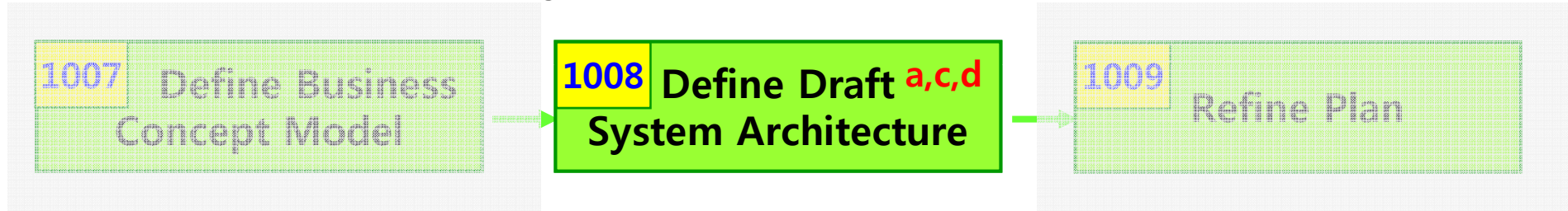
- Description
  - Construct a rough preliminary system architecture model
  - Input : requirements specification
            business use case model
  - Output : a draft system architecture
- Steps
  1. Define logical/physical layers of the target system
  2. Separate the whole system into several subsystems
  3. Assign business use cases into each subsystem
  4. Identify and draw up hardware resources
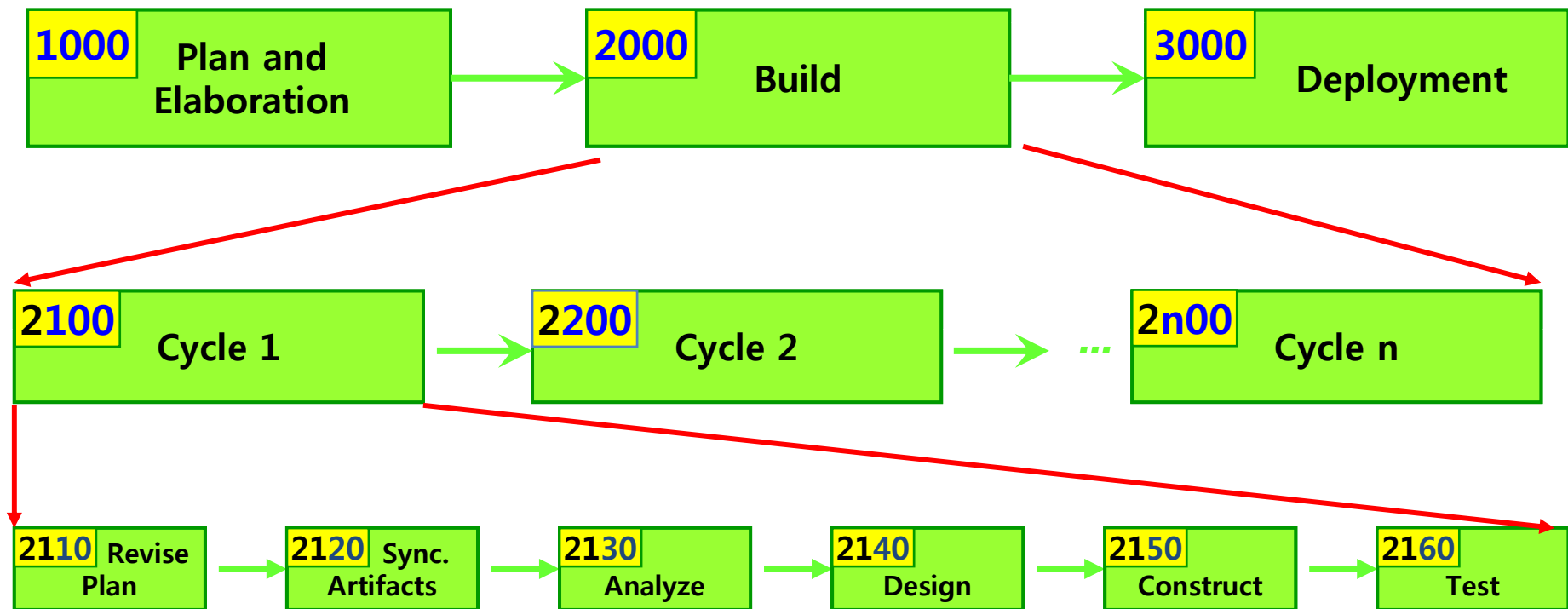
Activity 1009. Refine Plan

- Description
  - Refine the draft project plan generated in activity 1001
  - Input : all outputs of OSP stage 1000
  - Output: a refined project report
- Steps
  1. Review draft project plan, based on requirements specification, business use case model, business concept model, and draft system architecture
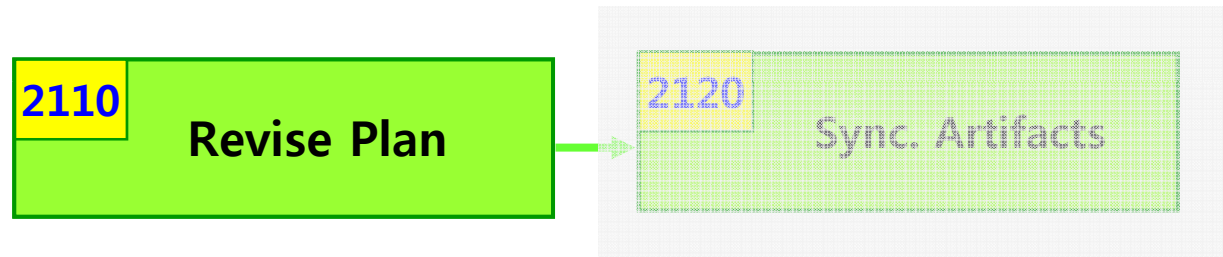 2. Refine project's scope, duration, cost, and other resources

Stage 2000.
Build

| 1000 **Plan and Elaboration** | → | 2000 **Build** | → | 3000 **Deployment** |

6 Phases of 'Build' Stage

1000 **Plan and Elaboration**	→	2000 **Build**	→	3000 **Deployment**

2100 **Cycle 1**	→	2200 **Cycle 2**	→ ...	2n00 **Cycle n**

2110 Revise Plan	→	2120 Sync. Artifacts	→	2130 Analyze	→	2140 Design	→	2150 Construct	→	2160 Test
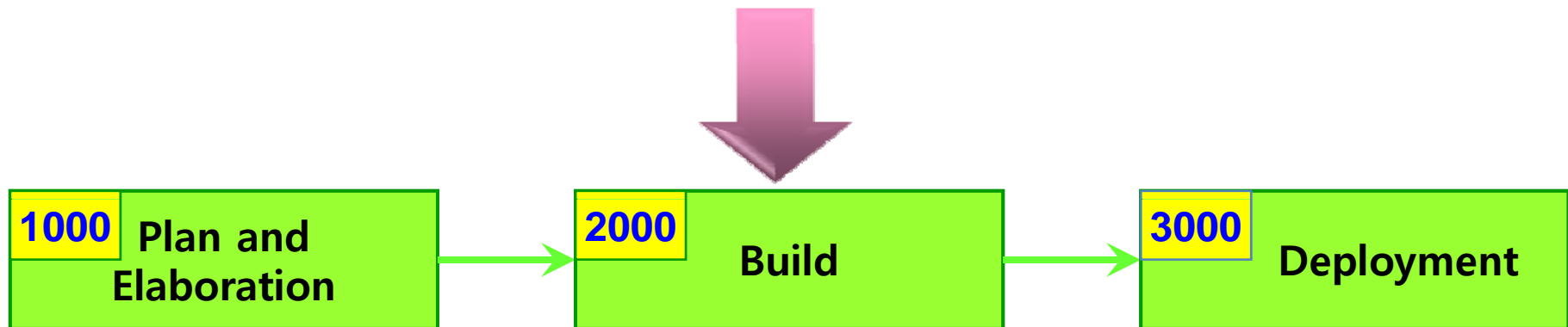
Phase 2010. Revise Plan

- Description
  - Correct and enhance the project plan and requirement definition based on the intermediate deliverables
  - Input : intermediate deliverables
  - Output : A refined project plan, a refined requirement specification
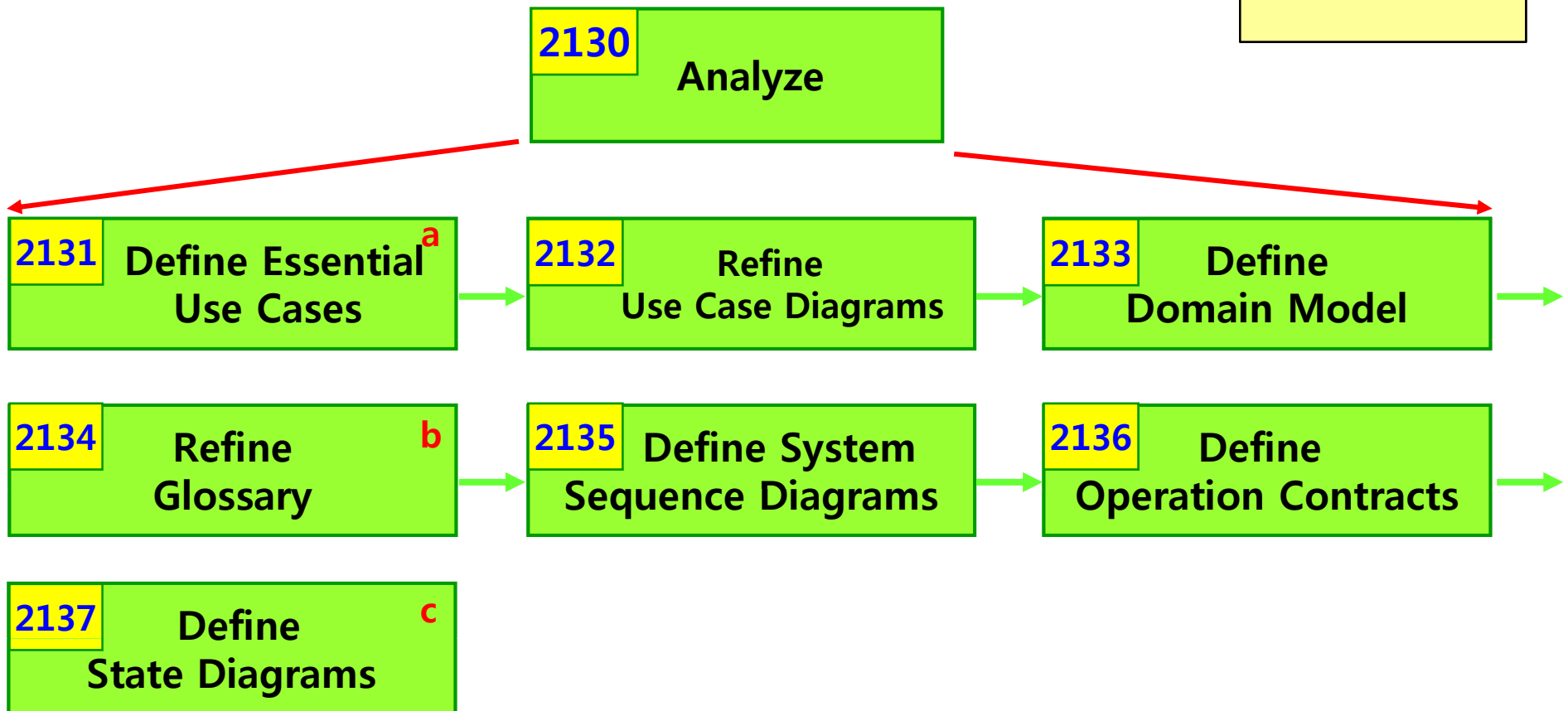- Steps

Phase 2020. Synchronize Artifacts

2110 Revise Plan	2120 **Synchronize Artifacts**	2130 Analyze

- Description
  - Configure and manage various types of artifacts (Project Repository)
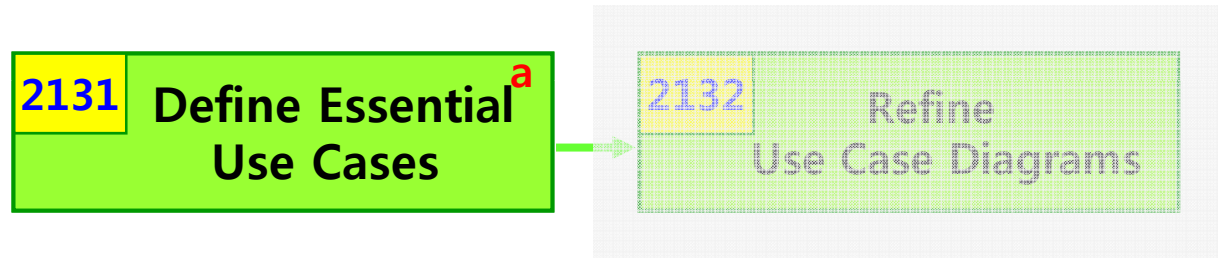 - Control versions and variations
  - Input :
  - Output :
- Steps

Phase 2030. Analyze

- Phase 2030 Activities

Note:
a. **if not yet done**
b. **ongoing**
c. **optional**

2130 Analyze

2131 Define Essential Use Cases a

2132 Refine Use Case Diagrams

2133 Define Domain Model

2134 Refine Glossary b

2135 Define System Sequence Diagrams

2136 Define Operation Contracts

2137 Define State Diagrams c

Activity 2031. Define Essential Use Cases

2131 **Define Essential Use Cases** [a]	2132 Refine Use Case Diagrams

- Description
  - Add event flows to business use case(high-level) descriptions
  - Input : business use case descriptions (activity 1006)
  - Output : An essential use case descriptions

| Use Case	Buy Items
Actor	Customer, Cashier
Purpose	Capture a sale and its payment
Overview	A Customer arrives at a checkout with items to purchase. The Cashier records the items and collects a payment, which may be authorized. On completion, the Customer leaves with the items.
Type	Primary and Essential
Cross Reference	Functions: R1.1, R1.2, R1.3, R1.7, R1.9, R2.1, R2.2, R2.3, R2.4 Use Cases: Log In use case
Pre-Requisites	N/A
Typical Courses of Events	(A) : Actor, (S) : System 1. (A) This use case begins when a customer arrives at the POST to checkout with items to purchase. 2. (A) The Cashier records each item.(E1) 3. (S) Determines the item price and adds the item information to the running sales transaction. 4. (A) On completion of item entry, the cashier indicates to the POST that item entry is complete. 5. (S) Calculates and presents the sale total. 6. (A) The Cashier tells the customer the total.
Alternative Courses of Events	...
Exceptional Courses of Events	E1: If invalid item identifier entered, indicate error.

Activity 2032. Refine Use Case Diagrams

| 2131 Define Essential Use Cases	2132 **Refine Use Case Diagrams**	2133 Define Domain Model
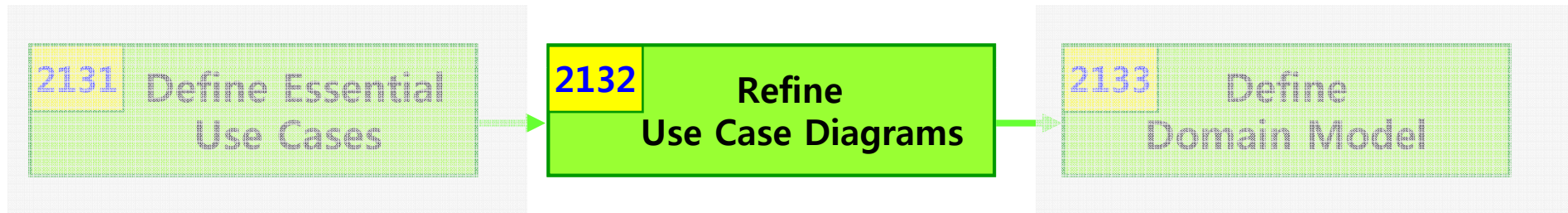
- Description
  - Validate and modify the 'Business Use-Case Diagram'
  - Input : business use case model, essential use case descriptions
  - Output : A refined use case diagram
  - Standard applied : UML's use case diagram
- Step
  1. Review business use case diagrams according to essential use case descriptions
  2. Refine use case diagrams by adding or refining use cases and relationships

Activity 2033. Define Domain Model

2132 Refine Use Case Diagrams	→	**2133** **Define Domain Model**	→	2134 Refine Glossary b
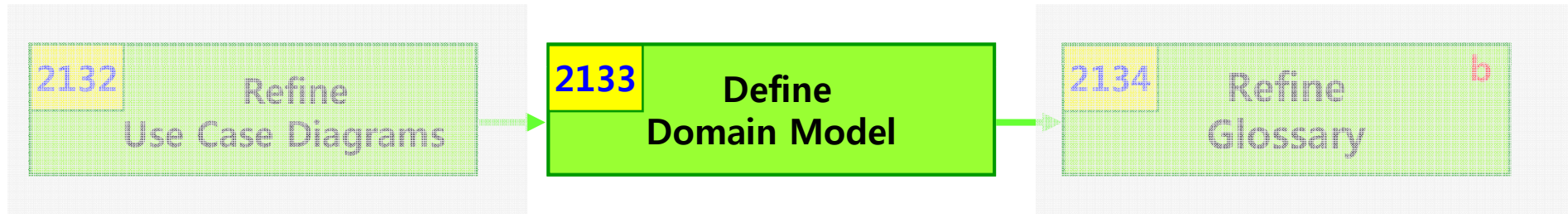
- Description
  - Define domain concept model by reviewing input artifacts
  - Input : essential use case descriptions, business concept model
 - Output : A conceptual class diagram

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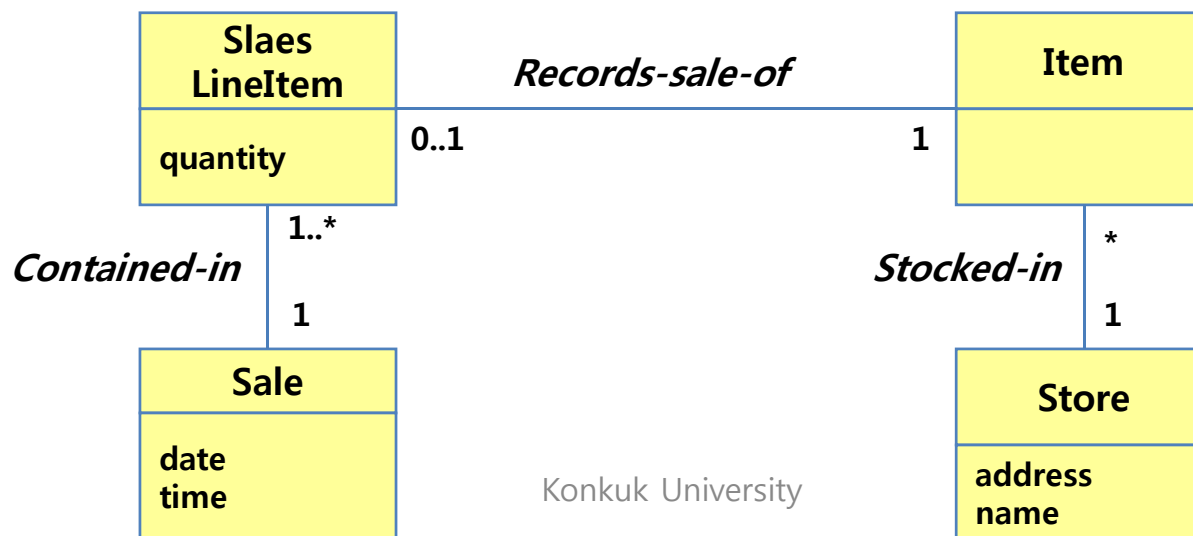
Activity 2034. Refine Glossary

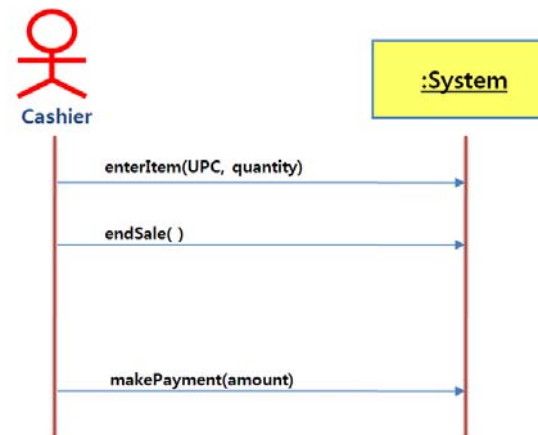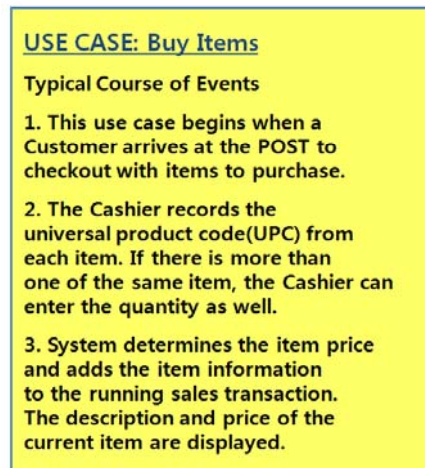| 2133 Define Domain Model	→	2134 **Refine Glossary** b	→	2135 Define System Sequence Diagrams

- Description
  - Lists and refines all the terms in order to improve communication and reduce the risk of misunderstanding
  - Input : term dictionary, essential use case descriptions, conceptual class diagram
  - Output : A refined term dictionary

- Step
  1. Refine terms defined in the Plan and Elaborate Phase(use cases, attributes, concept, etc.) during development cycle.
  2. Record terms as following format:

Term	Category	Comments
Payment	Concept (Class)	a cash payment
…	…	…

Activity 2035.
Define System Sequence Diagrams

| 2134 Refine Glossary	**b**	2135 **Define System Sequence Diagrams**	2136 Define Operation Contracts
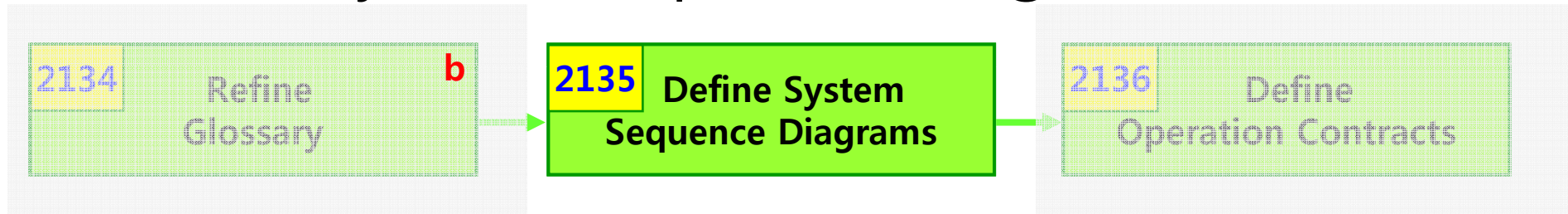
- Description
  - Illustrates events from actors to systems.
  - To investigate the system to build
  - Input : essential use case descriptions, use case diagram
 - Output : A sequence diagram

USE CASE: Buy Items

Typical Course of Events

1. This use case begins when a Customer arrives at the POST to checkout with items to purchase.

2. The Cashier records the universal product code(UPC) from each item. If there is more than one of the same item, the Cashier can enter the quantity as well.

3. System determines the item price and adds the item information to the running sales transaction. The description and price of the current item are displayed.

Cashier

:System

enterItem(UPC, quantity)

endSale( )

makePayment(amount)

Activity 2036. Define Operation Contracts

| 2135 Define System Sequence Diagrams	2136 Define Operation Contracts	2137 Define State Diagrams c

- Description
  - Define contracts for system operations
  - Input : system sequence diagram, conceptual class diagram
  - Output : Operation Contracts
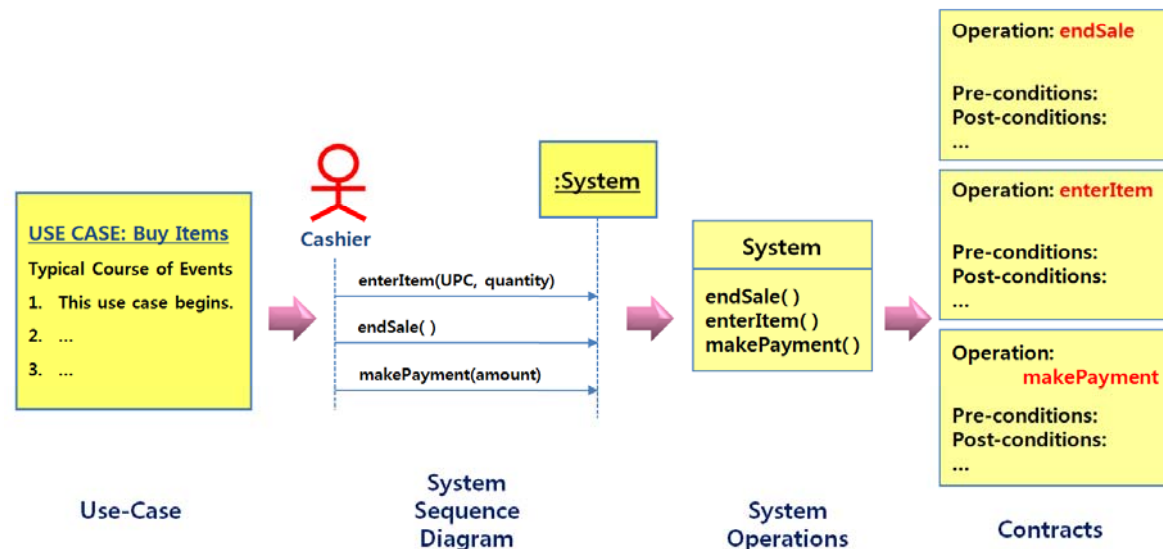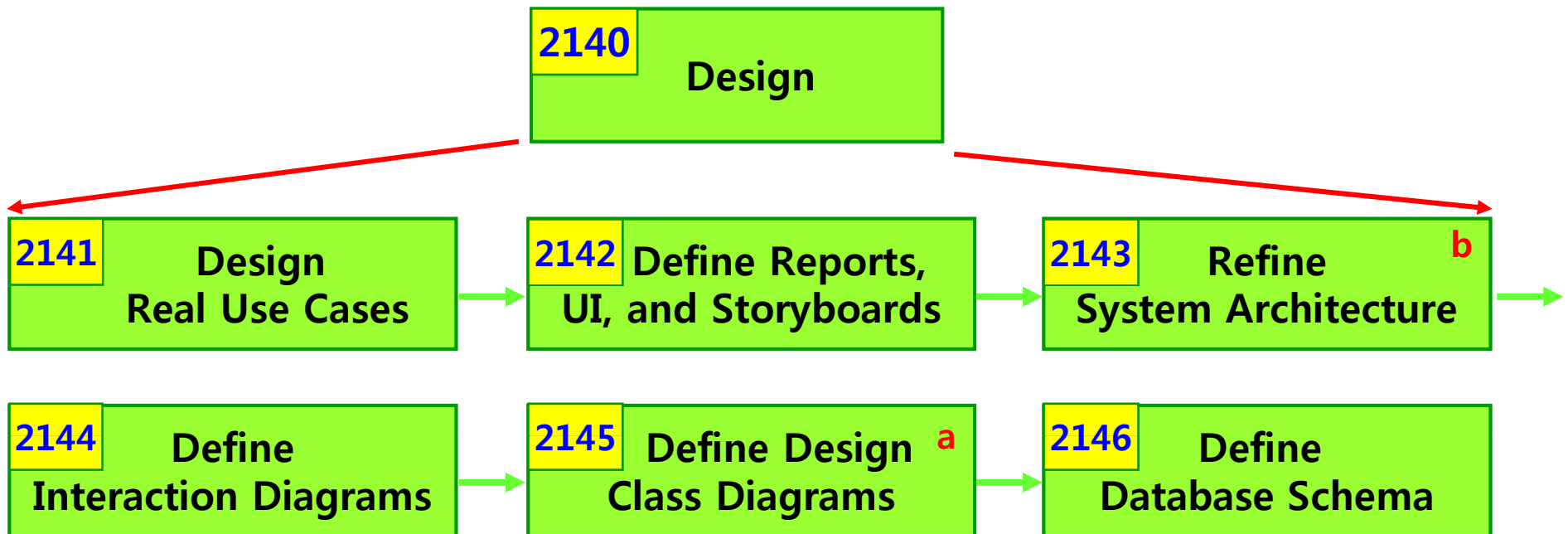
Activity 2037. Define State Diagrams
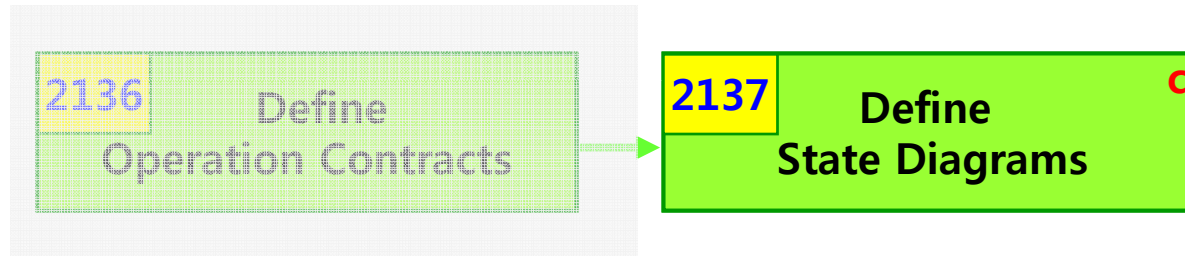
- Description
  - Describes all possible states of the system, use cases, or objects
  - Input : essential use case diagram, conceptual class diagram
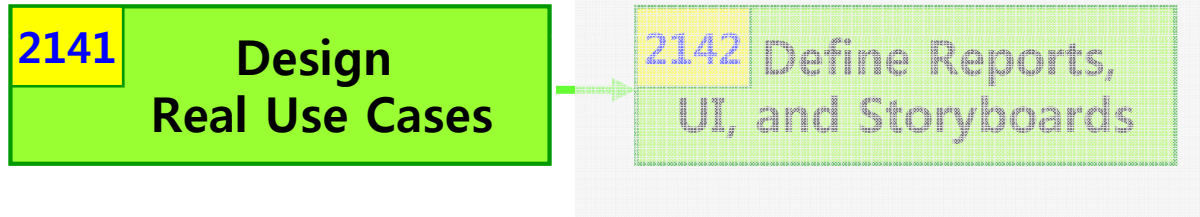 - Output : A state diagrams (for Use case, System, Class)
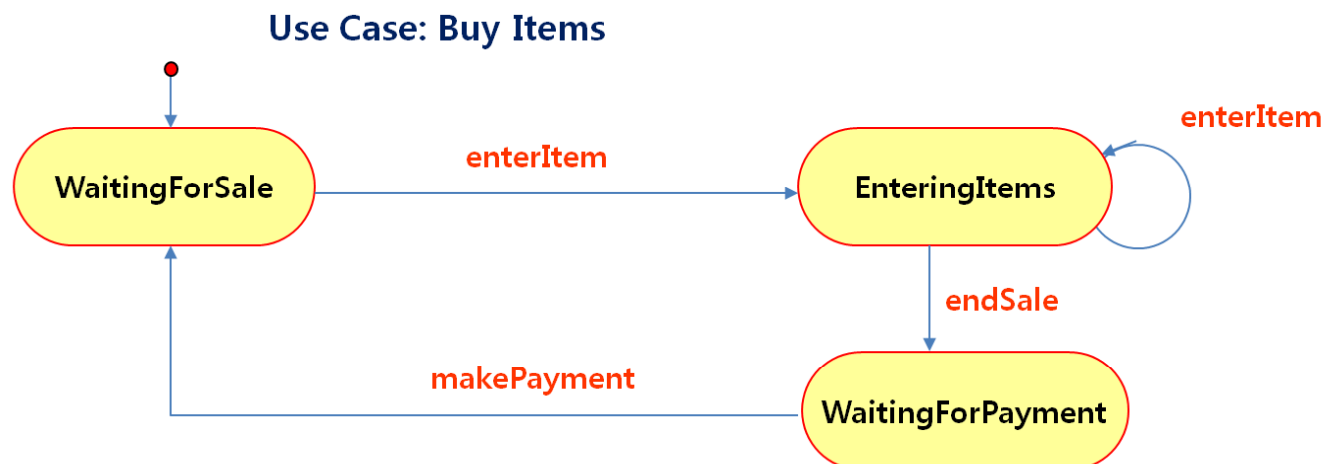
Phase 2040. Design

- Phase 2040 Activities

> a. **In parallel with interaction diagrams**
> b. **Varied order**

2140 **Design**

2141 **Design Real Use Cases**

2142 **Define Reports, UI, and Storyboards**

2143 **Refine System Architecture** b

2144 **Define Interaction Diagrams**

2145 **Define Design Class Diagrams** a

2146 **Define Database Schema**

Activity 2041. Design Real Use Cases
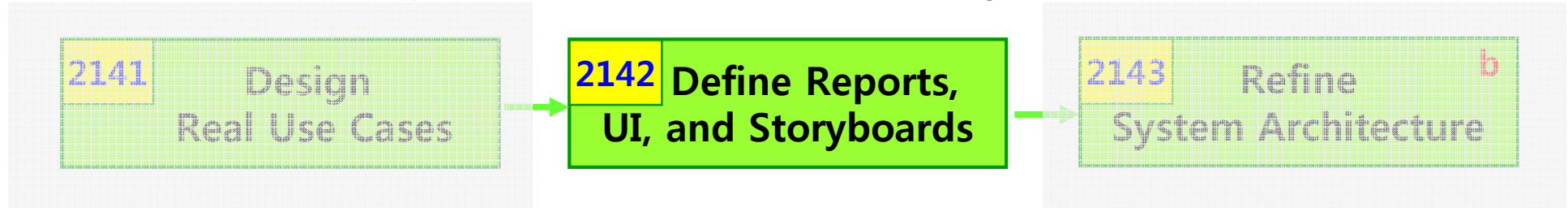

- Description
  - It describes real/actual design of the use case in terms of <u>concrete</u> input and output technology and its overall implementation.
  - If a graphical user interface is involved, the real use case will include diagrams of the GUI and discussion of the low-level interactions with interface widgets.

- Input
  - Essential Use Case Descriptions

- Output
  - Real Use Case Descriptions

| Use Case	Buy Items – Version 1 (Cash only)
Actor	Customer, Cashier
Purpose	Capture a sale and its cash payment
Overview	A Customer arrives at a checkout with items to purchase. The Cashier records the items and collects cash payment, which may be authorized. On completion, the Customer leaves with the items.
Type	Primary and Real
Cross Reference	Functions: R1.1, R1.2, R1.3, R1.7, R1.9, R2.1 Use Cases: Log In use case
Pre-Requisites	N/A
UI Widgets	Window-1
Typical Courses of Events	(A) : Actor, (S) : System 1. (A) This use case begins when a customer arrives at the POST to checkout with items to purchase. 2. (A) For each item, the Cashier types an UPC in A of Window-1. If there is more than one of an item, the quantity may optionally be entered in E. They press B after each item entry. (E1) 3. (S) Adds the item information to the running sales transaction. The description and price of the current item are displayed in B and F of Window1. 4. (A) The Cashier tells the customer the total.
Alternative Courses of Events	...
Exceptional Courses of Events	E1: If an invalid UPC is entered, indicate an error.

Activity 2042.
Define Reports, UI, and Storyboards

| 2141 Design Real Use Cases	→	2142 **Define Reports, UI, and Storyboards**	→	2143 Refine System Architecture b

- Description
  - Design UI storyboard and UI components.
- Input
  - Requirements Specification
  - Real Use Case Descriptions
- Output
  - UI Storyboard
  - UI Component Design Specification

Activity 2043. Refine System Architecture
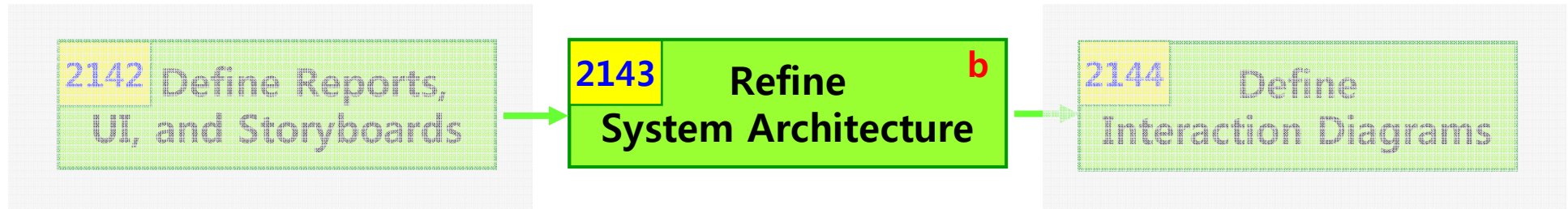
- Description
  - Refine draft system architecture developed in the plan stage
- Input : Draft System Architecture
- Output : A package diagram, a deployment diagram
- Standards Applied
  - UML's Package Diagram
  - UML's Deployment Diagram
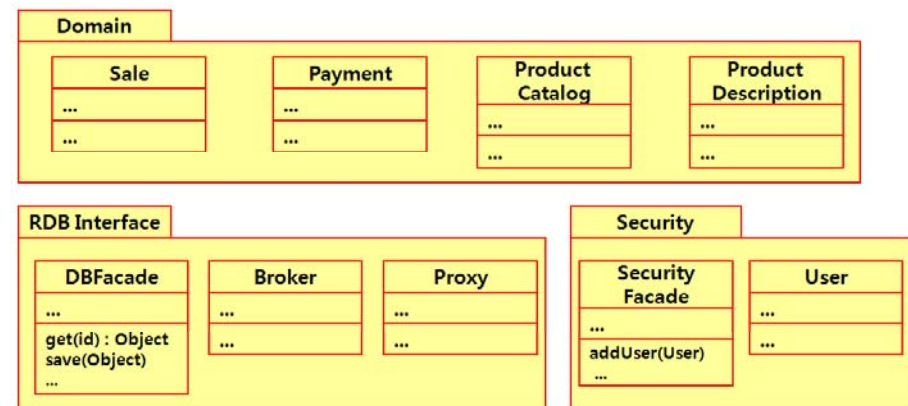
Activity 2044. Define Interaction Diagrams

| 2143 Refine System Architecture	2144 **Define Interaction Diagrams**	2145 Define Design Class Diagrams

- Description
  - Collaboration diagrams illustrate object interactions in a graph or network format.
  - To illustrate how objects interactions via messages to fulfill tasks.
- Input : Real Use Case Descriptions
- Output : An interaction diagram
 - Collaboration diagram
  - Sequence diagram
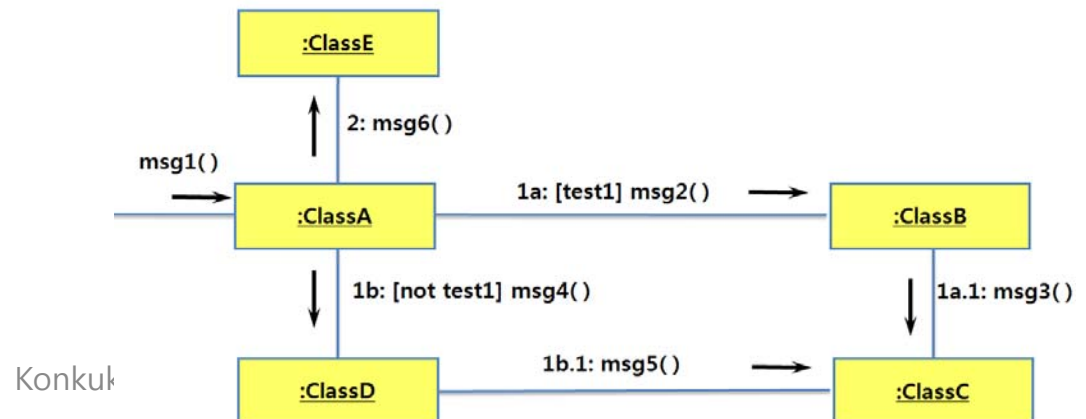
Activity 2045.
Define Design Class Diagrams

2144 Define Interaction Diagrams	→	2145 **Define Design Class Diagrams** [a]	→	2146 Define Database Schema

- Description
  - Describes more details in conceptual class diagram
  - Add navigability, dependency, data type, operation signature, parameters, return types, and so on.

- Input :
  - Interaction Diagram
  - Conceptual Class Diagram
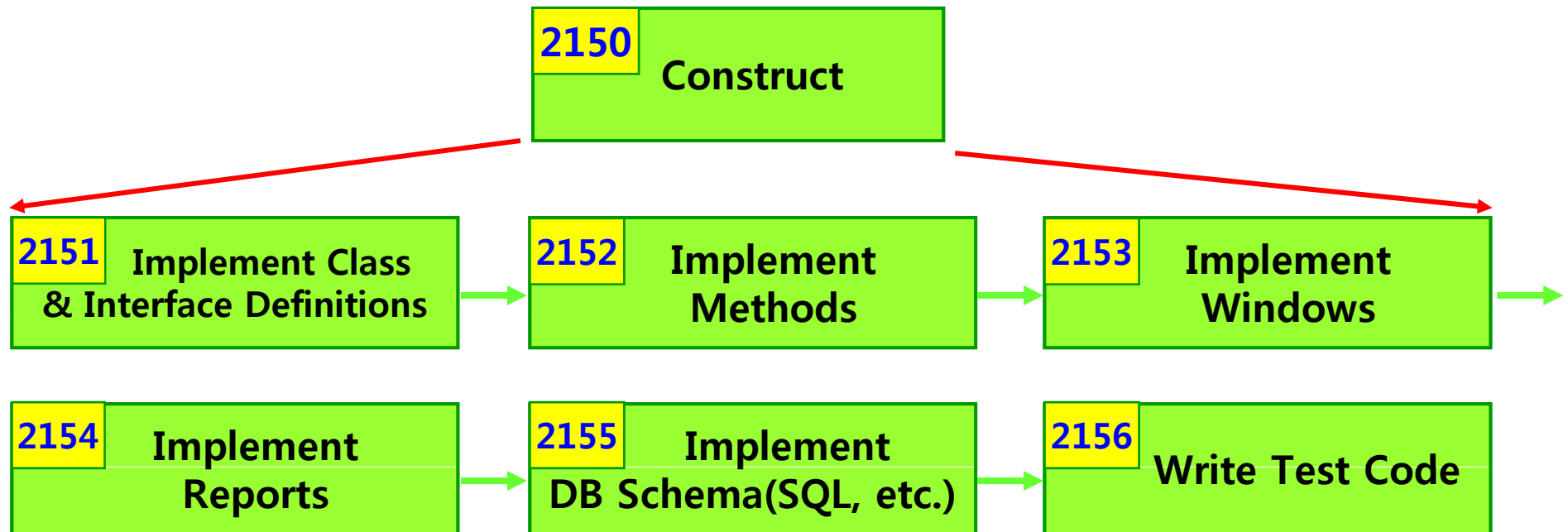
- Output : A Design Class Diagram
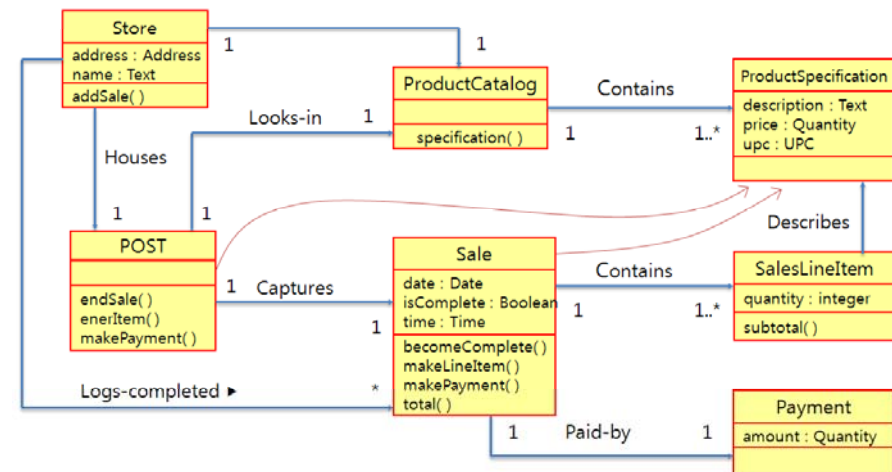
Activity 2046. Define Database Schema
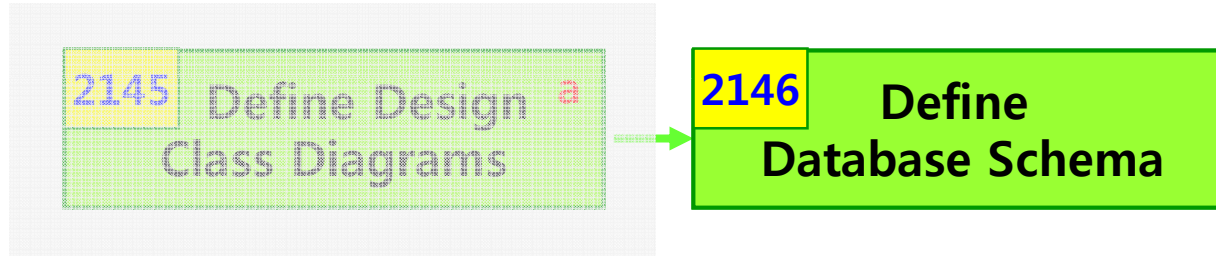
- Description
  - Design database, table, and records
  - Map classes into tables
- Input : Design Class Diagram
- Output : A Database Schema
- Steps:
  1. Map classes into tables
  2. Map relationships between classes into relations between tables
  3. Map attributes into fields of tables
  4. Design Schema

Phase 2050. Construct

- Phase 2050 Activities

```
              ┌──────────────────────┐
              │ 2150                 │
              │        Construct     │
              └──────────────────────┘
```

2150 Construct

2151 Implement Class & Interface Definitions → **2152 Implement Methods** → **2153 Implement Windows** →

2154 Implement Reports → **2155 Implement DB Schema(SQL, etc.)** → **2156 Write Test Code**

Phase 2060. Test

- Phase 2060 Activities

| 2160 | Test |

| 2161 Unit Testing | → | 2162 Integration Testing | → | 2163 System Testing | → |

| 2164 Performance Testing | → | 2165 Acceptance Testing | → | 2166 Documentation Testing |