Reasoning about dependencies amongst use case events

And the benefits of enaction

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Supporting Use Cases
Our context

SoSyM

- Elicitation. Process models, Use Cases and interfaces.
- Writing: Using writing rules, guidelines or templates.
- Assessing Quality.
- Comprehension: Questions and interrogation
- Validation and evolution
  - *Dependencies and enaction. TOOL SUPPORT.*
- Moving towards design.
  - Teasing out (hidden) issues.
  - Use case driven processes. Construction & validation

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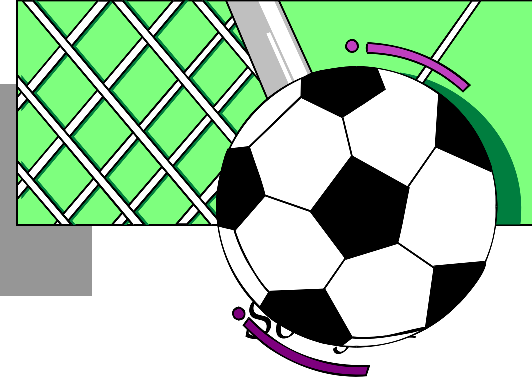
Two sporting use cases



1. The match reached full-time
2. The referee blew his/her whistle
3. The ball crossed the goal-line
4. The goal was not given

Alternatives

4. The goal was given

1. The match reached full-time
2. The referee blew his/her whistle
3. The ball crossed the goal-line
4. The goal was given

Alternatives

4. The goal was not given

Validation & Context. Someone who ‘knows the the game’.

Joining Threads

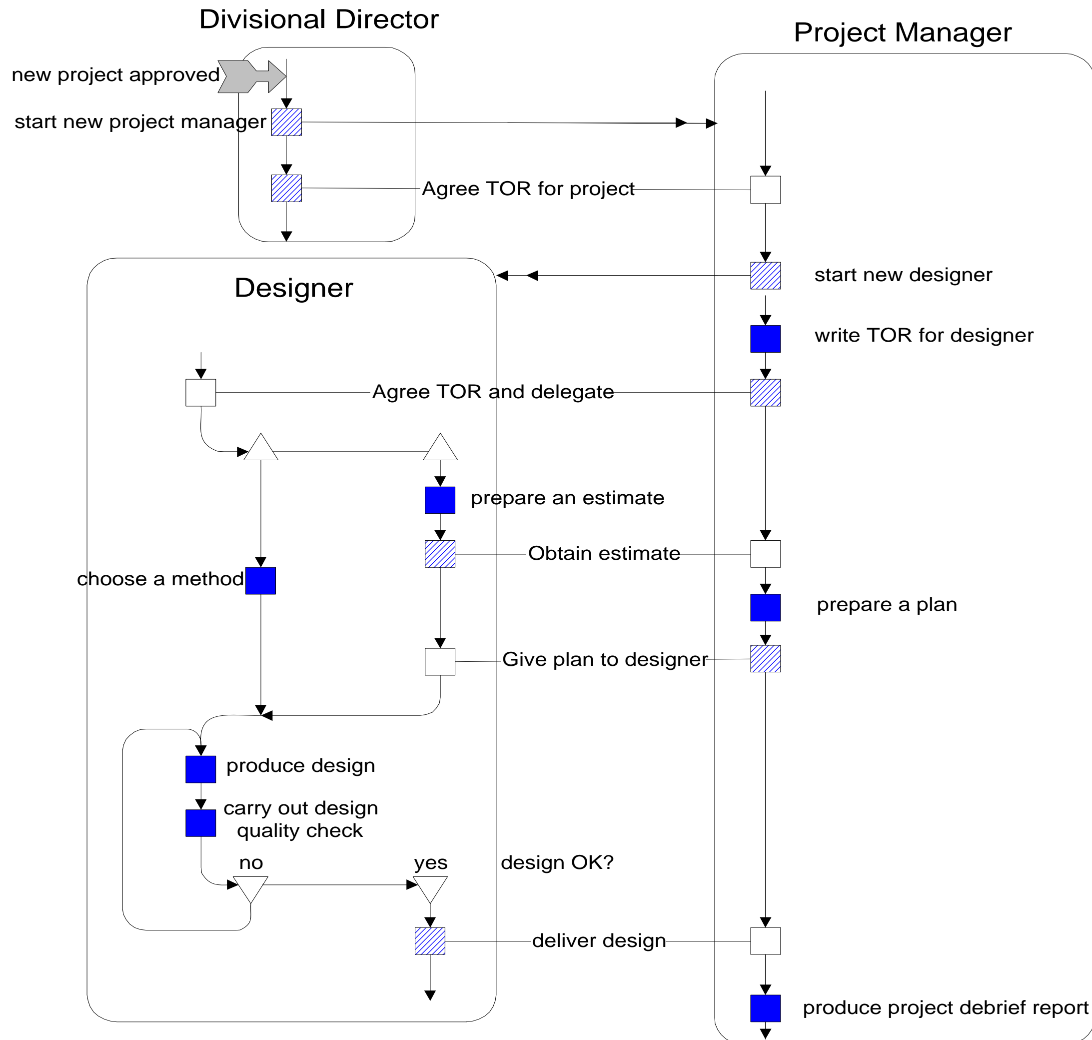
- Process modelling
- Role based models & enactable models
  - Involving *stakeholders*.
  - User-facing models. (***Audience***)
  - Industrial users: Like them but *too much effort*
- Use Cases (stuck with them)
  - Support for use case case guidelines
  - Importance of **Dependencies**
- Mapping
  - Problems moving from business models to specification – loss of 'richness'

Business model (strategic)

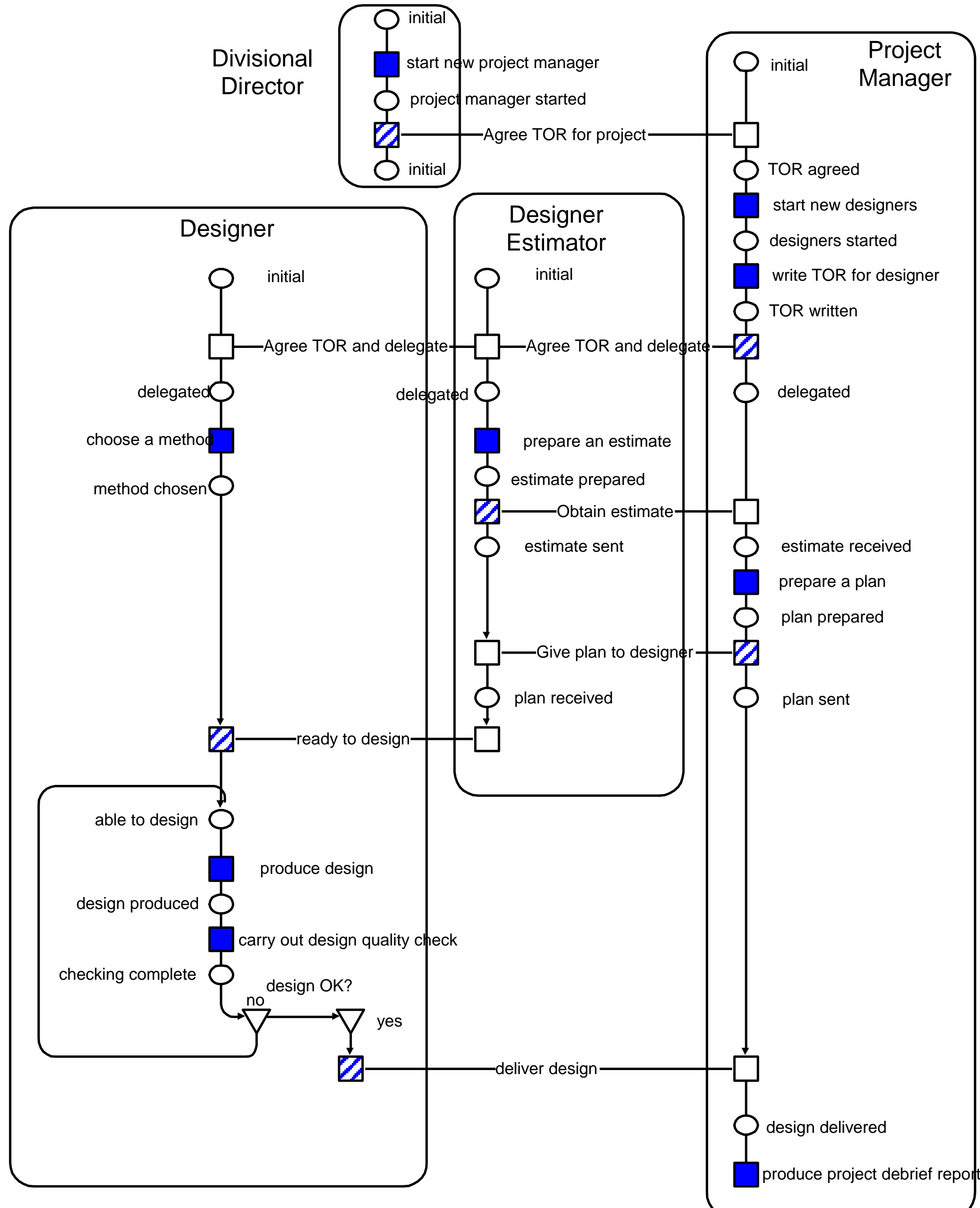
Process model (operational, e.g., RAD)

Use case (specification)

RAD (standard)



RAD with states



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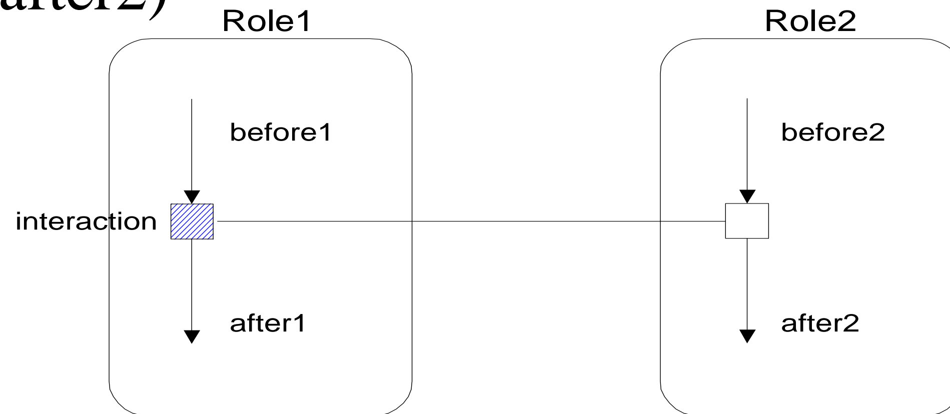
Interaction in RADs (as RolEnact code)

Interaction Role1.Interaction

Me(before1 → after1)

Role2(before2 → after2)

End




```
Interaction Designer.deliver_design
        me(accepted_design → design_sent)
        Project_Manager(plan_sent → design_received)
End
```

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Observations on RolEnact

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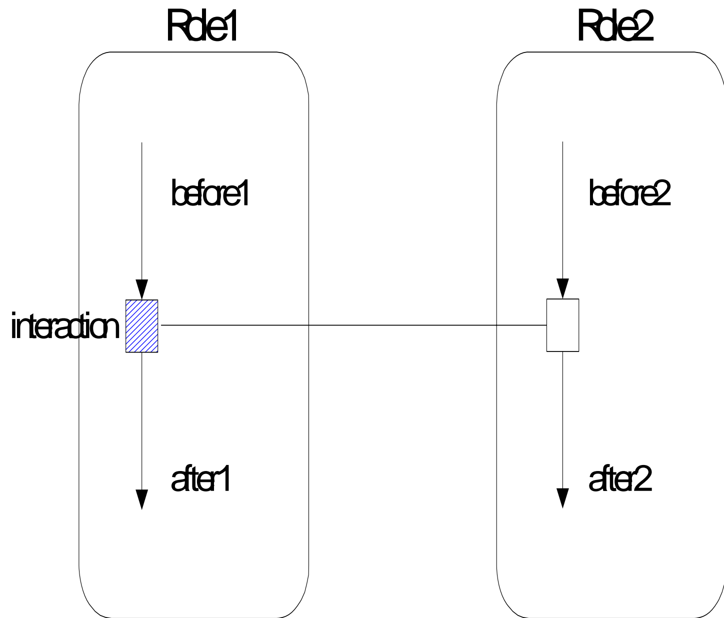
- Process (business) model as prerequisite to requirements or specification.
- ‘Disappointed’ by power of use case having used process models (such as RADs).
  - Enactable process models, versus static use case description.
  - Fewer options for control
  - *Information loss in moving towards specification.*
- Formal coding / annotating of use case descriptions too much effort (*especially for industrial collaborators*).

Enactable Use Case Tool

- Add pre-post to event (typically each line)
  - Interactions involve synchronisation of multiple actors.
  - Supports intra and inter-use case dependencies
  - Option to enact (order of enaction) being controlled by the pre / post *states* of events.
  - Forces consideration of dependencies amongst events.
- Allow greater stakeholder involvement.
  - Minimal (extra) effort for modeller.
- Allow traceability through from process model to use case (and beyond…)
  - Hence, don’t lose the benefits.

Three Notations




```
Interaction Role1.Interaction
Me(before1 → after1)
Role2(before2 →  after2)
End
```

```
Interaction Keith.gives_pen
        Me (has_pen -> no_pen)
        Karl (no_pen -> has_pen)
End
```

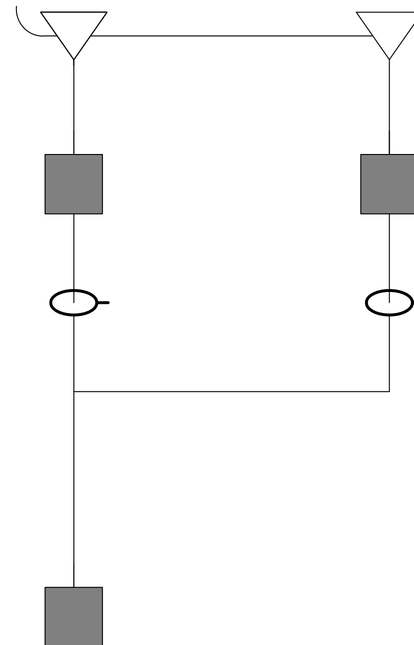
Actor	*Event*	*pre*	*post*	*Actor 2*	*pre*	*post*
Keith	gives pen	has pen	no pen	Karl	no pen	has pen

States and Conditions

Consider two 'independent' events, *get apples*, and *get oranges'*, of some actor (or role) each which result in the post states, *has apples* and *has oranges*.

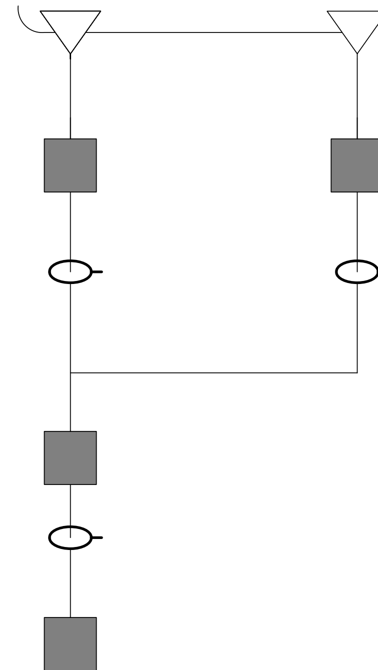
Third event, *make juice*, can occur when either apples or oranges have been obtained.

Traditionally, a guard on such an event might be a precondition such as *has fruit*.



States Only Model

Within Educator, the pre-state for make juice has to be an exact match and this requires an extra step.
The extra step brings together two threads (independent behaviours) into a single state, *has fruit*. That is, one can still arrive at the state *has fruit*, as a result of either thread.
Importantly, at any given time there is still only one state for the role (or actor), and hence a further simplification, for both understanding and implementation, is preserved.
However, since state change requires an action, this means that there is a need for a further (often artificial) action in order for the actor to be in some more general state (e.g., has fruit).



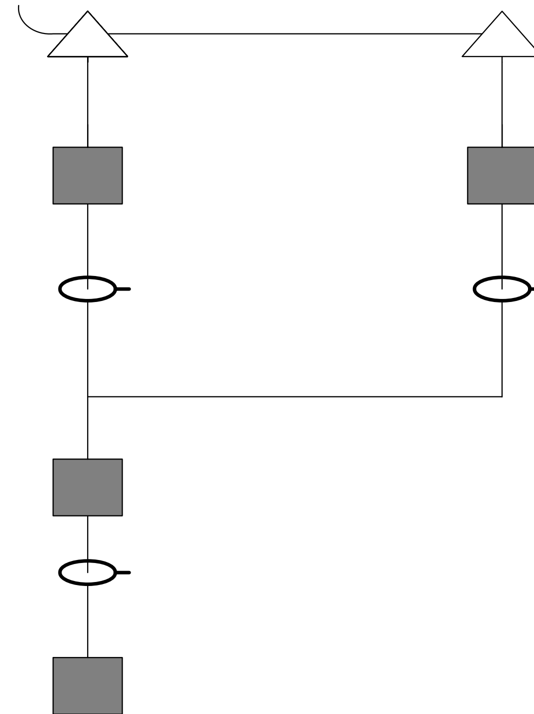
Parallel: Standard RAD view

Suppose our event is now *Make smoothie*, which requires that when we have fruit. We actually have both apples and oranges.

For a use case we would be required to choose that the gaining of apples and oranges occurs in some arbitrary sequence. That is:

1 Fruit Finder get apples
2 Fruit Finder get oranges

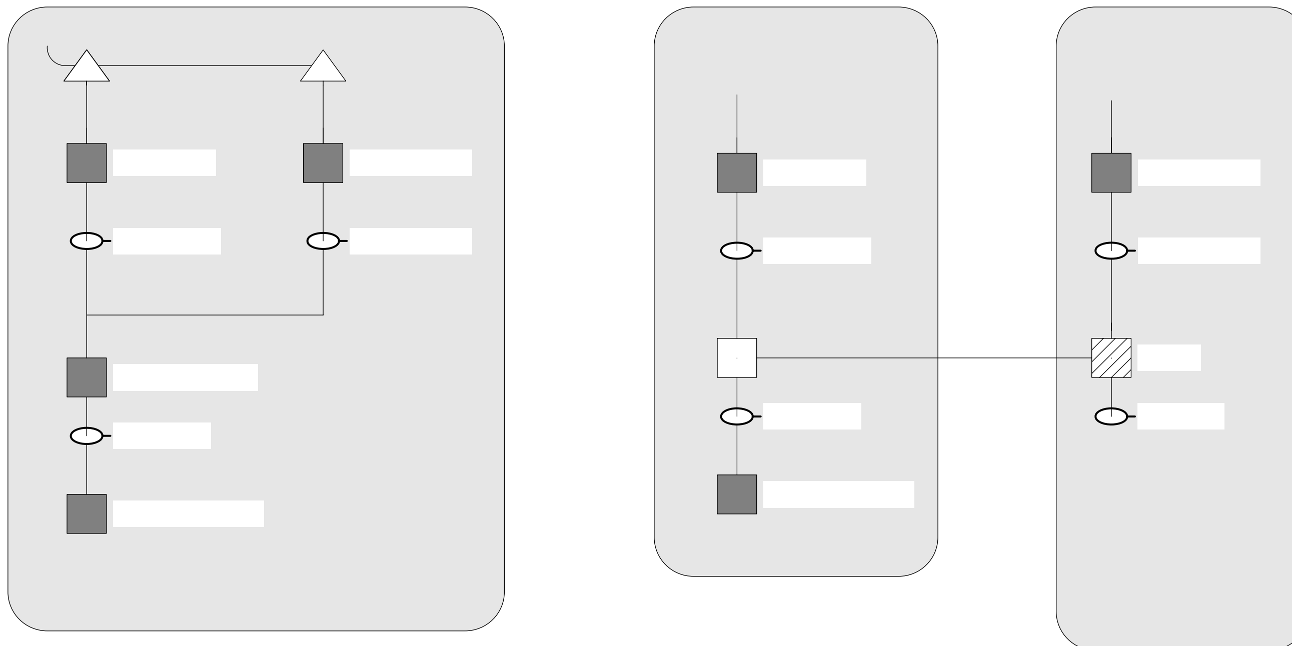
However, in reality one might gather these fruits independently and in any, often unknown order.



Parallel: Standard RAD view

We employ the mechanism of splitting the role into different roles, each of which carries one of the state variables (the having apples or oranges states).

Below is a RAD representation of role of *Fruit Receipt* (left) and the separate roles *Apple Receipt* and *Orange Receipt* (right):



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Enactable Use Case Tool

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- Add pre-post to event (typically each line)
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Strengths and Weaknesses

SoSyM

- Needs to spawn a role where there are multiple state variables.
- Additional roles highlight the fact that this other (independent processing) could be carried out by another resource, or may even be another role.
- Needs additional actions (or interactions) to join threads or to combine states.
- Classic precondition hides states or implies behaviour. Making states explicit forces consideration of the states of the process.
- The precondition also requires some understanding on the part of the reader (semantic load), which may not be obvious for unfamiliar models.
- A significant consideration is that the model is intended to be accessible by business users, or typical use case writers, who may not be familiar with state models (and indeed, will not carry that baggage). Hence, only one additional concept is required.

Simple (single UC) Enaction

Educator Use Case Enaction

File | Use Case | Actor | Conditions | Enact | Tools | CP Words | Help

Description: Course Registration

ID	Primary Actor	Event	Precondition	Postcondition	SecondaryActor	Precondition	Postcondition
1	Lecturer	volunteers for courses to teach	initial	coursesAgreed	Registrar	waiting	coursesAgreed
2	Registrar	prepares course list	coursesAgreed	listDone	Student	waiting	listDone
3	Student	chooses courses to stud	listDone	coursesChosen			

Add Description	Add Alternative path	Insert Event	Print
Change Precondition	Change Postcondition	Add Loop	Quit

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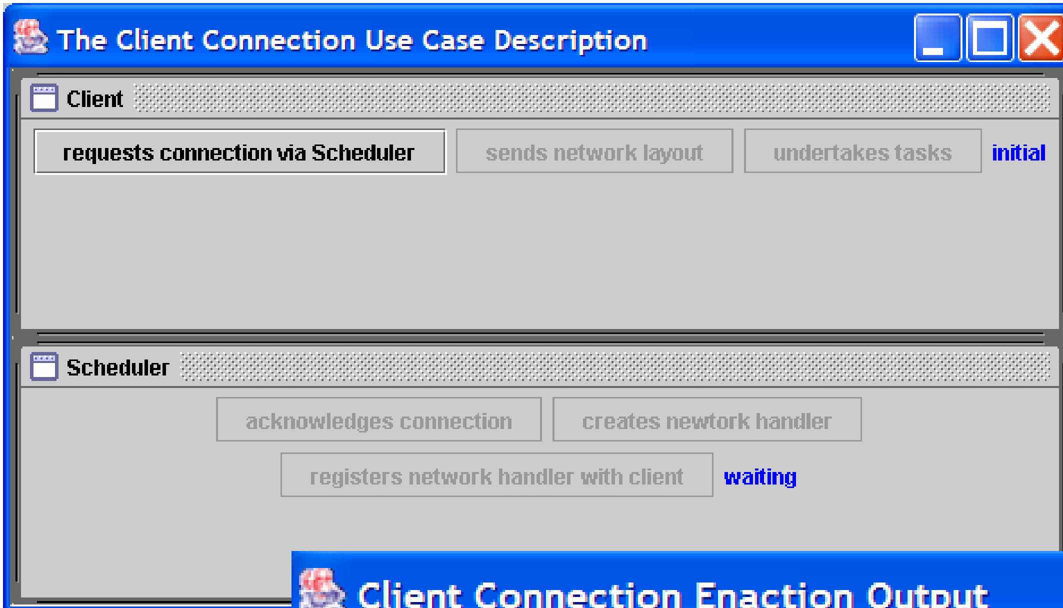
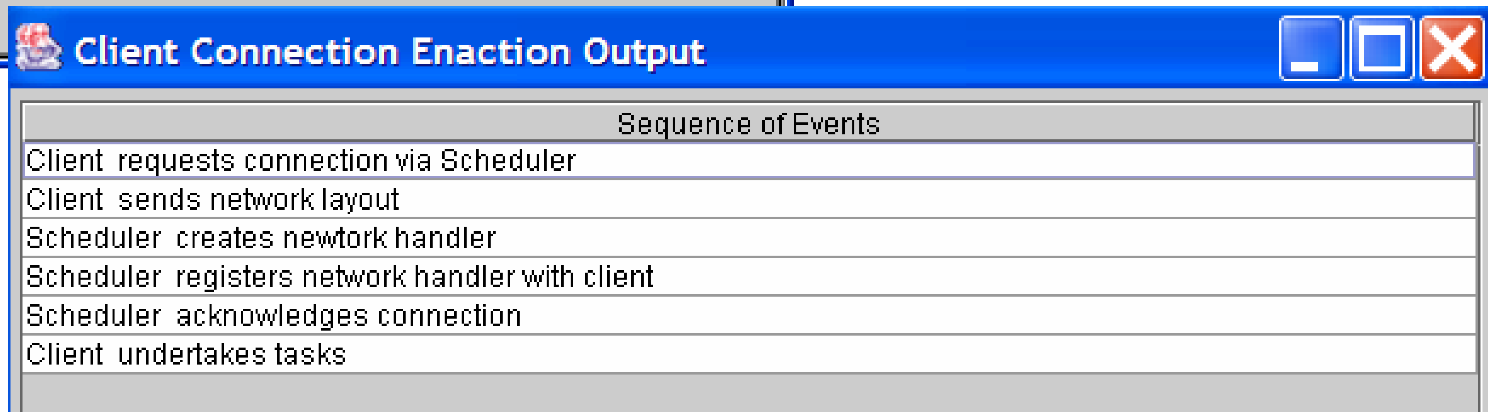
An Enaction…

SoSyM



Events re-ordered. New order is in effect: 1, 3, 4, 5, 2, 6

Of course, states not written order really control invocation of events.



Considering dependencies

1. Client requests connection via Schedule
2. Scheduler acknowledges connection
3. Client sends network layout
4. Scheduler creates network handler
5. Scheduler registers network handler
6. Client starts executing its tasks

Educator :Use Case Enaction

File Use Case Actor Conditions Enact Tools CP Words Help

Description: Client Connection

ID	Primary Actor	Event	Precondition	Postcondition	SecondaryActor	Precondition	Postcondition
1	Client	requests connection via Scheduler	initial	connectionRequested	Scheduler	waiting	connectionRequested
2	Scheduler	acknowledges connection	handlerRegistered	connectionAck	Client	handlerRegistered	connected
3	Client	sends network layout	connectionRequested	layoutSent	Scheduler	connectionRequested	layoutReceived
4	Scheduler	creates newtork handler	layoutReceived	handlerCreated			
5	Scheduler	registers network handler with client	handlerCreated	handlerRegistered	Client	layoutSent	handlerRegistered
6	Client	undertakes tasks	connected	readyToWork			

Add Description | Add Alternative path | Insert Event | Print

Change Precondtion | Change Postcondition | Add Loop | Quit

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Multiple use cases

SoSyM

- Consider a course registration process described with the following use case events:
- 1. Lecturer volunteers for courses to teach.
- 2. Registrar prepares course list.
- 3. Student chooses course to study.

Related Use Cases

Primary Actor	Event	Pre state	Post state	Secondary Actor	Pre state	Post state
Lecturer	gives pen	hasPen	noPen	Student	noPen	hasPen
Student	gives pen	hasPen	noPen	Lecturer	noPen	hasPen

Primary Actor	Event	Pre state	Post state	Secondary Actor	Pre state	Post state
Lecturer	volunteers for courses to each	initial	coursesAgreed	Registrar	waiting	coursesAgreed
Registrar	prepares course list	coursesAgreed	listDone	Student	waiting	listDone
Student	chooses course to study	listDone	coursesChosen			

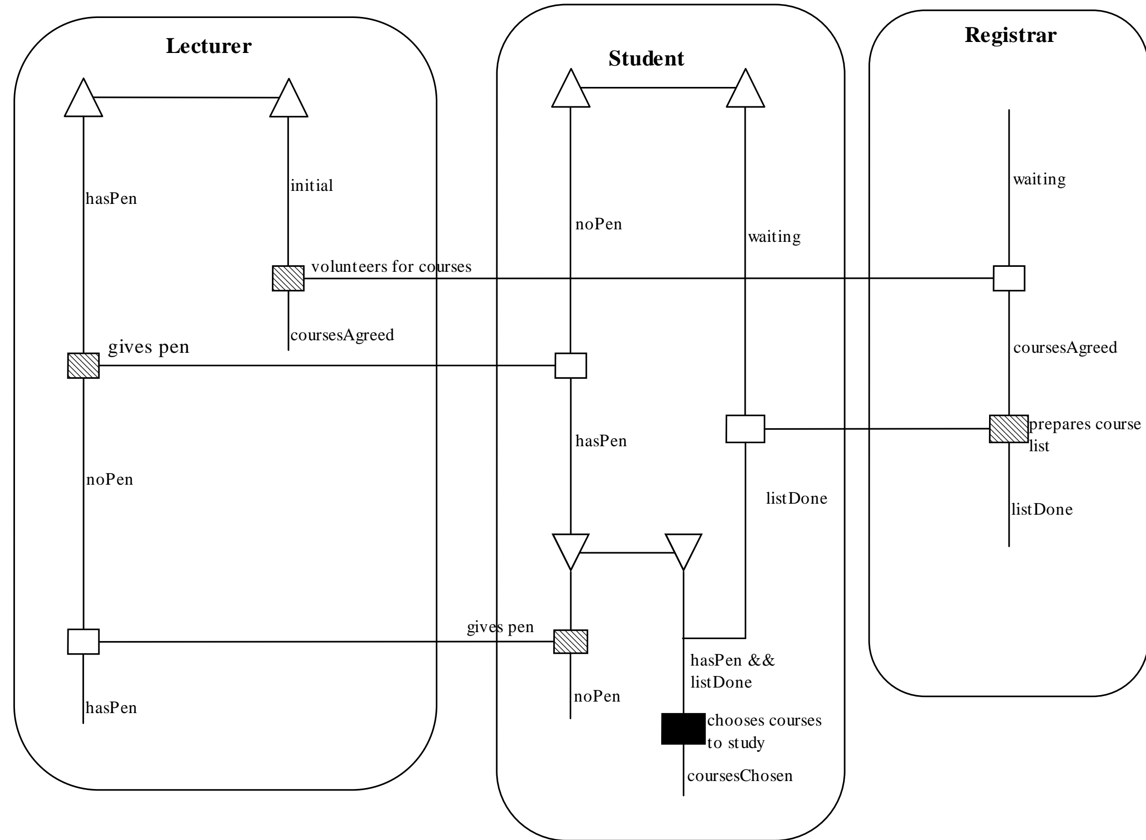
Parallel: Standard RAD view

Groupings are:

a) **Standard roles, as for a normal RAD**

b) By use case (ignoring roles or actors)

c) By separating each actor that is involved in multiple use cases into separate unique roles, where each role represents that actor for a particular use case, and is named accordingly.



Use Case View

Groupings are:
a) Standard roles, as for a normal RAD
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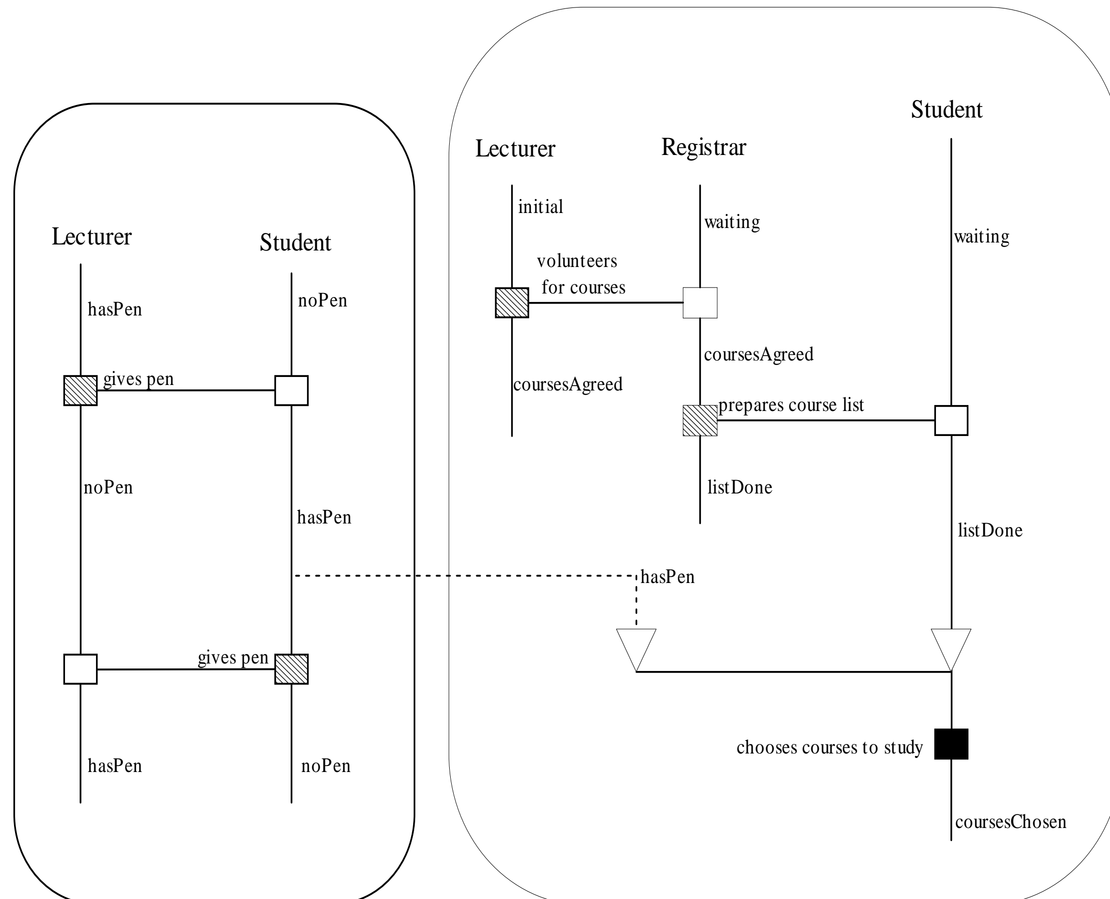


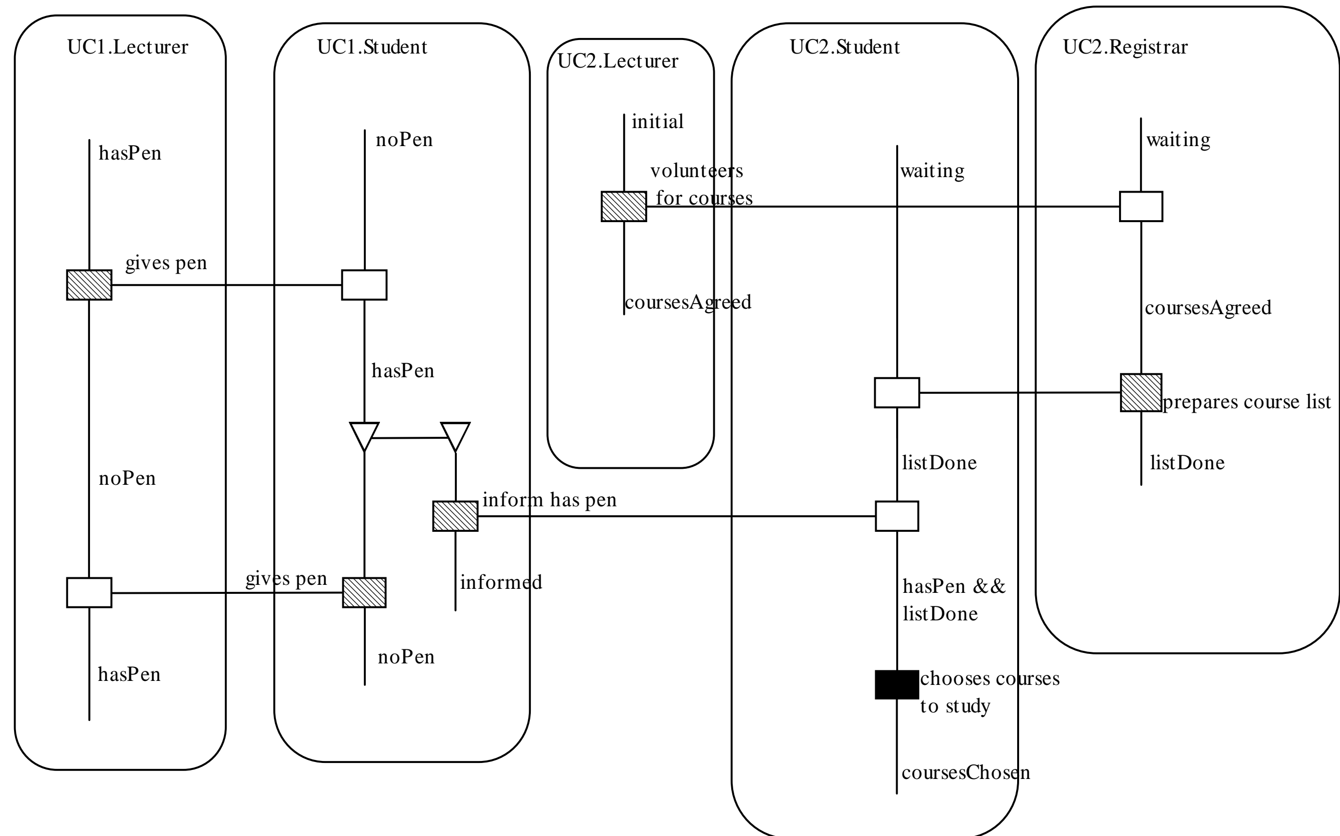
Unique Roles

Groupings are:

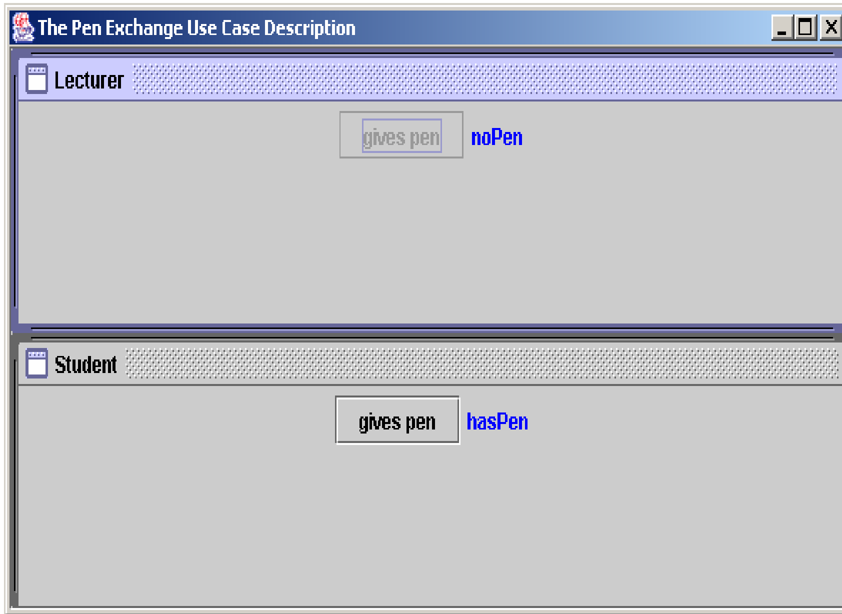
a) Standard roles, as for a normal RAD

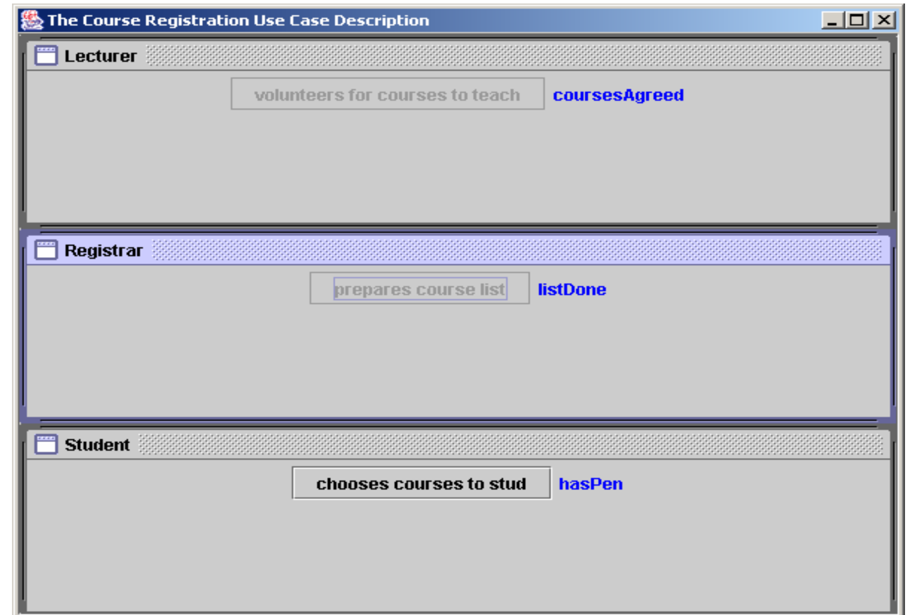
b) By use case (ignoring roles or actors)

c) By separating each actor that is involved in multiple use cases into separate **unique roles**, where **each role represents that actor for a particular use case**, and is named accordingly.



Parallel threads





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Findings & Conclusions

SoSyM

- Relatively easy to represent RAD with equivalent UCD
  - Maintains mapping and to aid alignment of process and use cases.
  - Though, in reality often orthogonal perspectives.
- Enaction aids discussion with stakeholders.
- Consideration of dependencies AND enaction both lead to greater ***shared understanding***.
- Some process issues cannot be depicted easily.
  - Still can't represent timing or NFRs
  - Use notes indicating aspects that cannot be coded as states, actors or events.
- Even this simple augmentation to use cases can seem tricky to non-technical users

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Issues for tool support

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- Does the increased capability offered by dependencies enhance or overcomplicate descriptions?
- Will the inclusion of use case writing guidelines restrict the flexibility offered by enaction?
- Does the template approach to structuring use cases fit more naturally with tool support?
- Will requirements volatility make dependency mapping unmanageable?
- Do users really require models that consider dependencies across use cases, or does the restriction to consideration within a use case provide a partitioning of understanding?