SoSyM
Software Systems Modelling Group

Improving the Quality of Use Case Descriptions:
Empirical Assessment of Writing Guidelines

Keith Phalp
Software Systems Modelling Group

Talk for the Computing Seminar Series,
Bournemouth University, May 2006

NICTA

SoSyM Collaborators

National ICT Australia — Australia's ICT Research Centre for Excellence

- NICTA was formed by the Australian Federal Government's Department of Communications, Information Technology and the Arts, and the Australian Research Council. NICTA's consortium partners are the Australian Capital Territory Government, the New South Wales Government, the University of New South Wales, and the Australian National University.
- NICTA's Empirical Software Engineering research program (ESE) is the hub of Australian research in this area and is the primary link to other leading empirical research programs internationally. ESE works closely with the Australian ICT industry, helping to implement new engineering processes and methods that increase competitive advantage and product quality. Major areas of research include:
  - Software process
  - Software requirements and risk
  - Software architecture
- NICTA formed recently, but links to group members since early 90s. Collaboration continues, with recent joint publications with KP and JV

Overview / Context

Improving the Quality of Use Case Descriptions

- Why Use Case Descriptions
- Guidelines for Use Case Descriptions
- Comparing guidelines (This study)
- Measuring the Impact of Guidelines for Structure (H1)
- Results for Impact of Structure Guidelines.
- An ‘independent’ assessment of quality – the 7Cs of communicability.
- Measuring impact of guidelines on communicability of use case descriptions (H2)
- Results for communicability.
- Analysis and Conclusions
- Further developments

Rationale: Guidelines

Improving the Quality of Use Case Descriptions

- Use cases popular and widespread.
- Little to guide the user, particularly for the description.
- Problems of structure and comprehension (and the importance of both requirements and specification).
- *Previous studies* suggest improvements when guidelines applied.
- Suggestion that application of existing guidelines might be problematic.
- Some issues with previous studies.
- **Aim**: Take the principal factors which had a positive impact on use case quality and to distil these into a smaller, more applicable set of rules.

Problems with studies

Improving the Quality of Use Case Descriptions

In essence, the argument often goes:

- Treatment 1 – No guidelines given (normal)
- Treatment 2 – Give subjects guidelines or rules
- Result: *"When we gave subjects the rules we found that more of them used the rules".* REALLY.

- Hence, why not compare the impact of rules against other (admittedly similar) rules?
- **Aim revisited**: A '*cut-down*' set of guidelines to perform 'as well as' (or better) than the leading approach.
- Test against the leading approach (the CREWS guidelines). Just consider structure guidelines here.

Hypothesis for Structure

Improving the Quality of Use Case Descriptions

- **H1** The constructs suggested by the CP rules are found in significantly higher numbers than the equivalent CREWS guideline constructs when both guideline sets are applied to the same problems.

- *In other words: Do they follow the rules we gave them?*
- Two sets were (could be) compared:
- CP1 versus CG5 and
- CP2 versus CG1-3

Comparing Guidelines

Improving the Quality of Use Case Descriptions

CP Structure 1: Subject verb object. For example,
The operator presses the button.
CG5: <agent> <action> <object>. For example,
The operator presses the button.

CP Structure 2: Subject verb object prepositional phrase. For example,
The system reminds the operator to save all the open files.
CG1: <agent> <'move' action> <object> from <source> to <destination>. For example,
The clerk sends the report from the store to the office.
CG2: <source agent> <'put' action> <object> to <destination agent>. For example,
The clerk gives the report to the manager.
CG3: <destination agent> <'takes' action> <object> from <source agent>. For example,
The manager gets the report from the clerk.

Background

Improving the Quality of Use Case Descriptions

- 60 students were formed into four experimental groups. (There had been a smaller pilot).
- Each group of comparable ability
- Two treatments across two set problems.

Group	Guidelines	Use case task
A	CP Rules	ATM
B	CP Rules	Retail
C	CREWS Guidelines	ATM
D	CREWS Guidelines	Retail

Analysis for H1

Improving the Quality of Use Case Descriptions

- No difference between A and C (both sets)
- Significant difference B to D (both sets).
- A positive interpretation is leaner CP rules perform as well or better than in producing the desired structure constructs
- However, pilot study reported that CP fared better with the ATM problem and that results with retail were not significantly different.
- Variation might also suggest that the effects are relatively small.
- *It does seem that the smaller CP rules perform at least as well, and possibly better, in guiding the structure of use case descriptions.* BUT…

Communicability

Improving the Quality of Use Case Descriptions

- H1: and similar studies *still* have element of self-fulfilling prophecy.
- In order to judge use case quality we adopt a set of quality factors, or use case facets,
- Mark quality according to these ‘independent’ quality criteria (facets).
- These facets are derived primarily from discourse process research, and other research in use case description.
- Consideration primarily to allow a degree of independent assessment.
- Some dependency inevitable: rules influence writer to produce desirable qualities.

Hypothesis for Communicability

Improving the Quality of Use Case Descriptions

- **H2:** Use case descriptions produced with the CP rules score significantly better than the equivalent CREWS use case descriptions, when marked against the 7Cs use case quality facets.

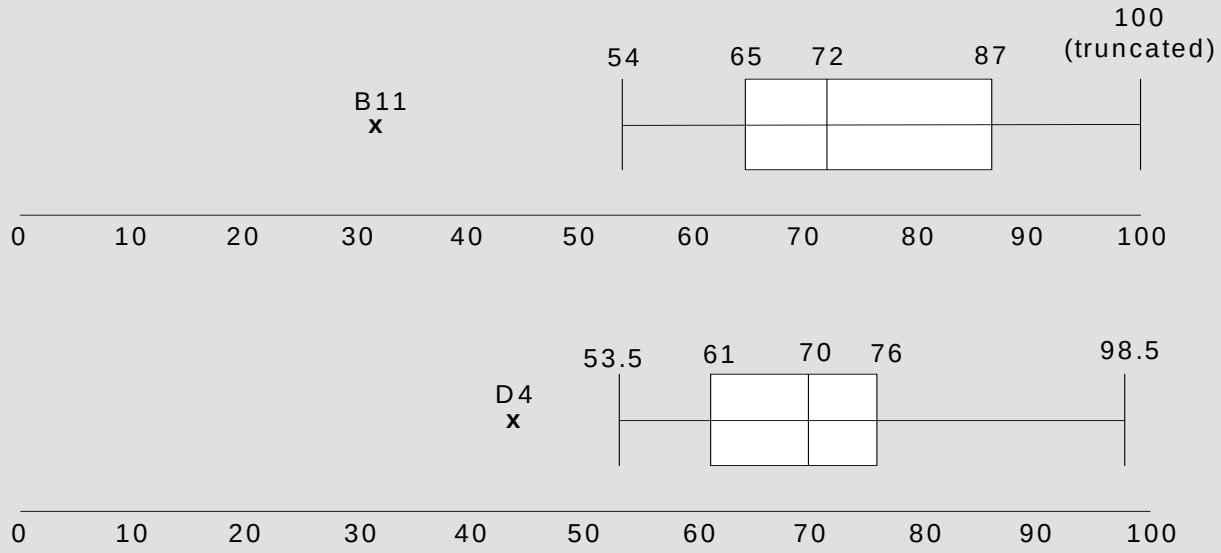
- *In other words does the fact that rules are being followed actually produce better use case descriptions.*

- Where better is judged according to the quality criteria.
- Actually allocate numerical marks
- *Worried about this even though we do it all the time.*

Results for H2

Improving the Quality of Use Case Descriptions

Group A	35	53	56	58	60	62	64	66	68	69	69	70	73	73	90
Group C	22	29	36	55	57	61	62	63	69	70	75	76	77	82	82
Group B	32	56	62	65	67	69	71	72	76	78	79	87	89	92	95
Group D	44	58	60	61	61	65	69	70	71	71	76	76	76	82	97
Means	Group A: 64.4, Group C: 61.07						Group B: 72.67, Group D: 69.13								
Std Deviation	Group A: 12, Group C: 18.77						Group B: 15.99, Group D: 12.19								



- 12 out of 15 of group B scored higher marks than group D.
- Paired t-test (single tailed) reveals a highly significant difference between the scores

Relating H1 to H2

H1		H2	
CP rules	**CREWS rules**	**CP rules**	**CREWS rules**
A	**C**	**A**	**C**
No difference in rule usage		**No difference in quality**	
CP rules	**CREWS rules**	**CP rules**	**CREWS rules**
B	**D**	**B**	**D**
B used rules significantly more		**B significantly 'better' descriptions**	

Analysis: H1 and H2

Improving the Quality of Use Case Descriptions

- For groups A and C the CP rules appear to perform slightly better - though not significantly so.
- However, we do find a highly significant difference in the performance of groups B and D, in favour of the CP rules.

- More importantly, the results suggest that guideline usage and overall quality are related.
- That is, where CP rules led to an increase in the structures found within the use case (H1), the quality assessment also confirmed that these appear to be better descriptions (H2).
- Similarly, we find no significant improvement in communicability where the rules are applied no better.
- Increased usage (of both rule sets) does appear to improve communicability. *For both sets of guidelines, when more rules are applied the resulting use case descriptions are improved.*

Conclusions

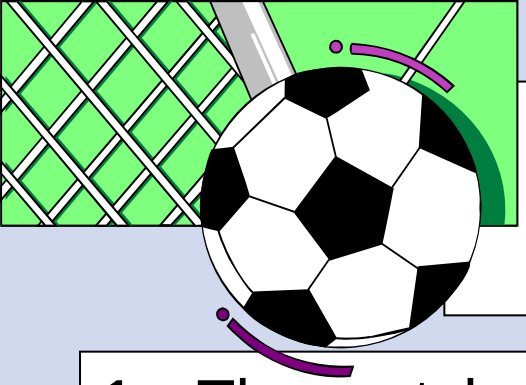
Improving the Quality of Use Case Descriptions

- Small ‘cut down’ set of guidelines (CP rules), compared with proven CREWS Use Case Authoring Guidelines
- *Both sets attempt to produce desirable structures in descriptions.*
- CP rules produced a significantly greater number of such structures for only one scenario.
- Then assessed descriptions against a set of quality criteria (H2).
- Found where there were significant differences in the number of structures (application of guidelines) use case quality was also significantly different.
- Study suggests that even differences in the number of times such structures are found may account for differences in the quality of the use case descriptions.
- *However, little difference in the performance of the CP Rules and the CREWS guidelines (although as good or better).*
- *Does suggest that adoption of a minimal set of guidelines is practical.*

Issues and Further Work

Improving the Quality of Use Case Descriptions

- Use cases still very valuable and popular.
- However, further problems with use case descriptions
- Notably they don't describe **dependencies** among events.
- Can't consider intra or inter use case event **dependencies**.
- Problems moving from business models to specification – loss of 'richness'. (*REBNITA issues*).
- Some problems in moving towards design, detail available (*bursary in moving towards design*).
- Some users 'disappointed' by 'power' of notation.
- Issues suggest need for augmentation with (typically state based) information.
- Need to keep intuitive structure.
- Need to minimise effort on the part of the use case author.
- Need for support to help adherence to guidelines.
- Therefore, consider simple to use tool support.
- ***Benefits of enaction***.



Dependencies: 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

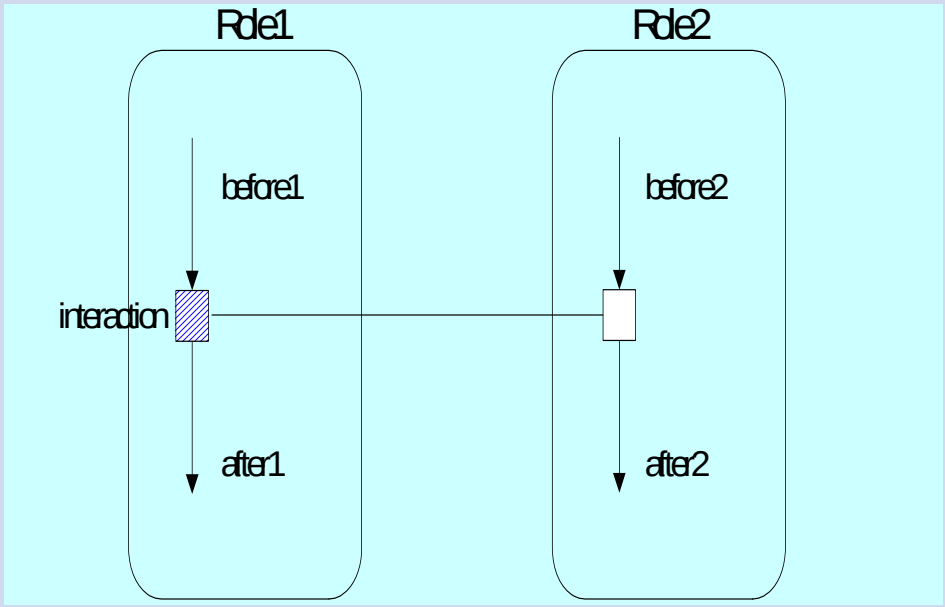
4. The goal was not given

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

Enactable Use Cases

Improving the Quality of Use Case Descriptions

- Use 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.
- Allows greater stakeholder involvement.
- Minimal (extra) effort for modeller.
- Allows traceability through from process model to use case (and beyond…)
- Hence, don’t lose the benefits



RADs to UCD

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

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

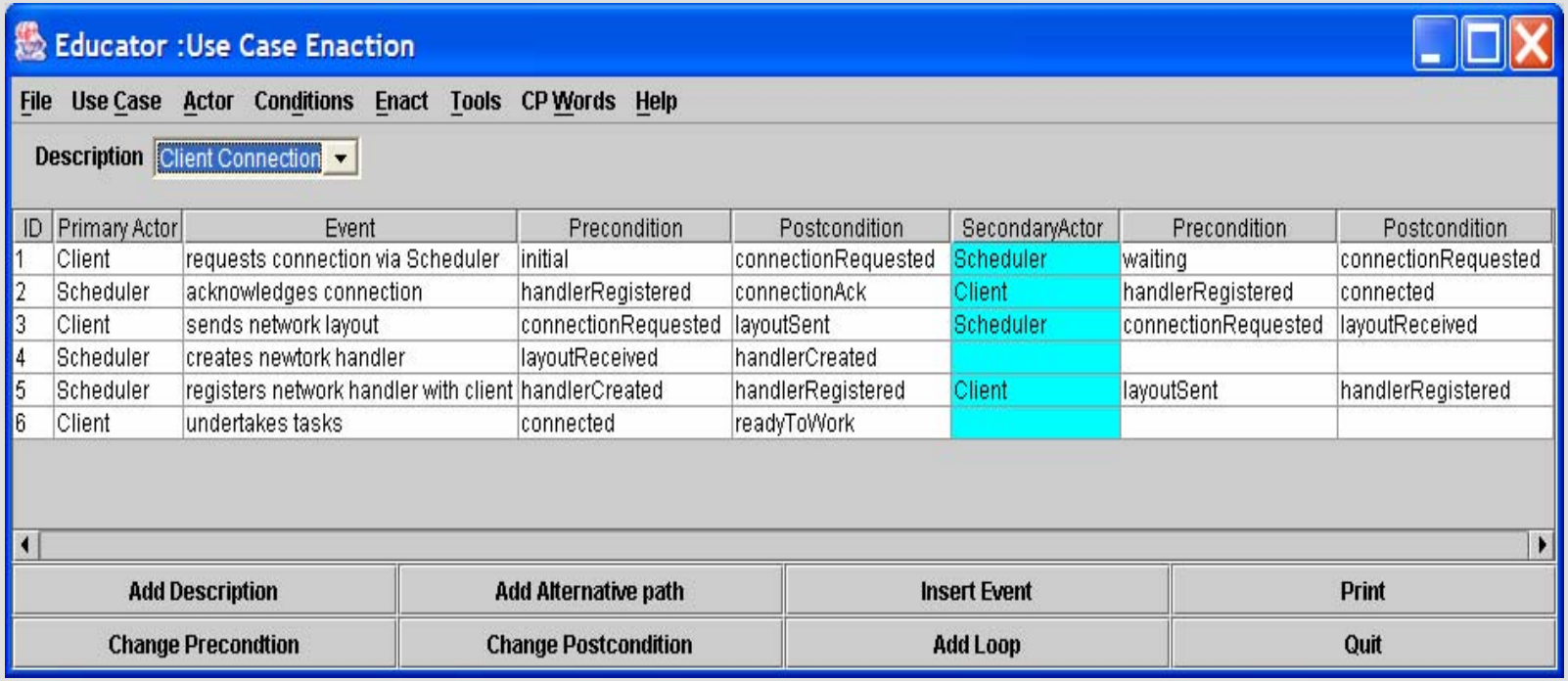
MATCHING USE CASE FORM

Actor	*Event*	*pre*	*post*	*Actor 2*	*pre*	*post*
Lecturer	gives pen	has pen	no pen	Student	no pen	has pen

EDUCATOR

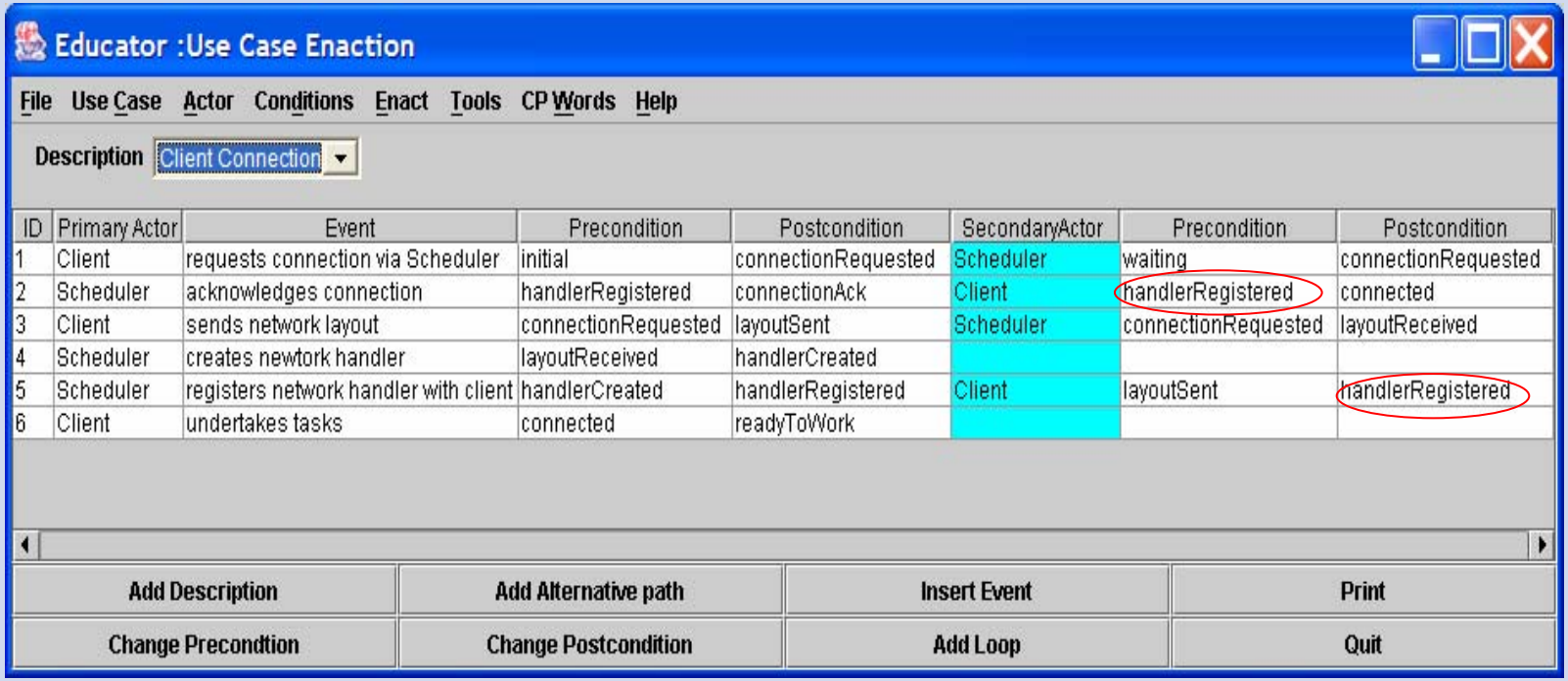
Further Developments

- Follows from previous project on use case guidelines.
- Supports the analysis of use cases, by using state information (added) to control the logic of an enaction.

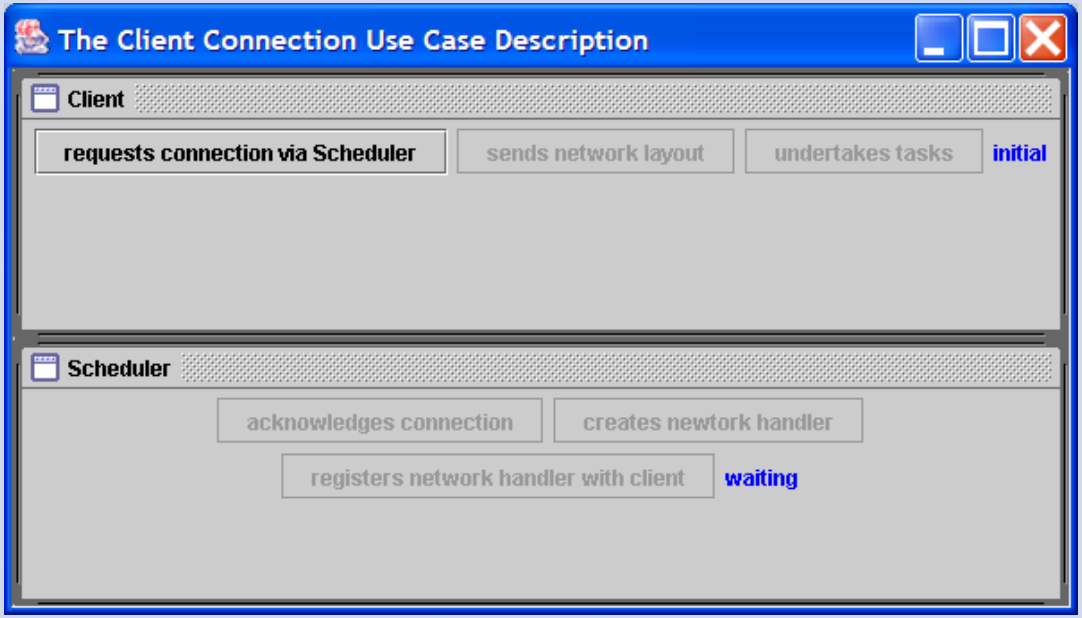


1. Client requests connection via Schedule
2. Scheduler acknowledges connection
3. Client sends network layout
4. Scheduler creates network handler
5. Scheduler registers network handler
6. Client starts executing its tasks

Dependencies

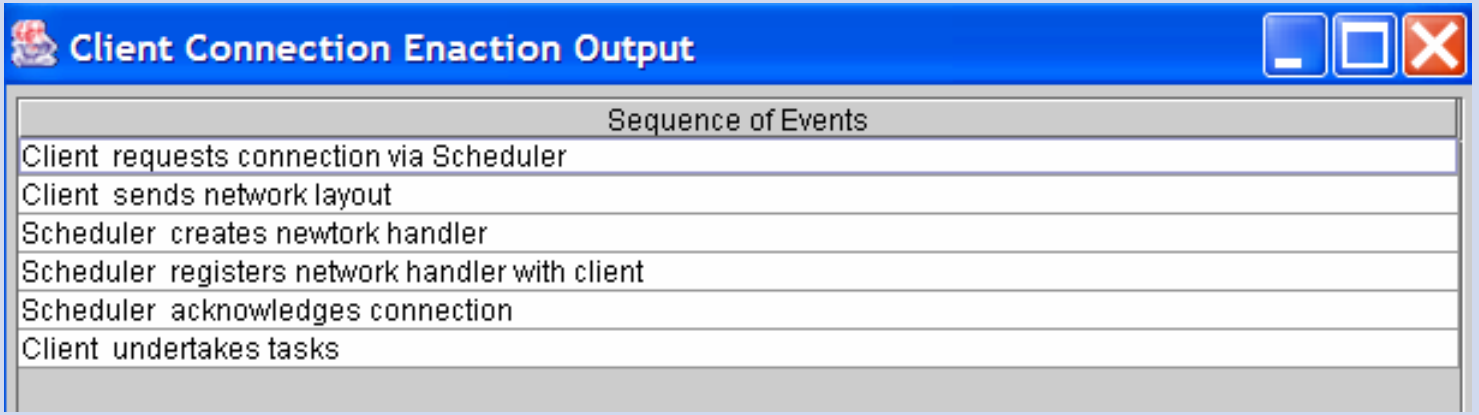


Enaction



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.



More Conclusions

Improving the Quality of Use Case Descriptions

- Use cases popular but flawed, particular the descriptions.
- *Guidelines seem to help.*
- Simple guidelines (such as CP rules) appear to be as effective as more complex sets (diminishing returns).
- However, comprehension actually more complex (current project to consider levels of comprehensions)
- Also some studies suggest that guidelines need to be tied to purpose (e.g., some better for simple requirements validation whereas others force consideration of design issues).
- Need tool support, since this aids:
  - adherence to rules,
  - validation through rigour and enaction,
  - preservation of mapping from process to specification.
- *Now need to consider how to extend tool support to use the specification to derive 'first cut' design notations, such as class or sequence diagrams. (Pilot already carried out).*

H1: Results Tables

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	33	33	0	4	29	50	47	16	83	61	20	33	62	70	31
C	35	25	48	10	65	50	45	33	69	62	18	46	79	20	33
B	6	33	45	30	6	57	24	14	22	29	36	30	42	12	22
D	4	0	23	0	25	38	35	5	15	0	18	45	18	0	13
α = 0.05	**A, C p = 0.30**					**B, D p = 0.02**					**AB, CD p = 0.27**				

Table 2: CP structure 1 versus CREWS equivalent

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	0	0	0	0	0	33	5	37	0	0	0	5	0	23	8
C	8	13	5	3	4	23	0	7	6	15	0	4	0	0	0
B	50	33	36	17	22	29	29	14	33	14	18	40	16	29	17
D	21	15	38	23	15	0	6	35	16	25	18	0	0	0	0
α = 0.05	**A, C p = 0.34**					**B, D p = 0.004**					**AB, CD p = 0.02**				

Table 3: CP structure 2 versus CREWS equivalent