

Analysis of Models

...Using models to analyse processes and qualities of models

Recap – So far.

- We have reviewed what we mean by analysis and requirements (and found issues with current and past methods).
- We have used business process models to understand better and to inform requirements and specification.
- We have examined 'what we want' from such models, considered alternatives and introduced role models.
- We have tried out Role Activity Diagrams – at the same time discussing other aspects of the analysis – noting issues and finding improvements.
- We have discussed issues in moving from process model to specification – and examined different proposed solutions.
- *Now consider how the model can be used within the analysis task.*
- *That is, often the model allows us to 'spot things', but how can we help ourselves to uncover such issues.*
- *What else would help here (e.g., metrics)?*
- *How else do we consider model quality (use case example)?*

What makes a good model?

- Heuristics for models.
 - We examine those for RADs.
- Measures for models
 - Static models. Counts. (Hence, CHASM).
 - Enactable models. Frequencies.
- Quantifying. Measures from heuristics.
- Example metrics.

Heuristics

- Caveat. Most useful heuristics depend on understanding the business process.
- Ould suggests four kinds of improvements:
 - Point-wise improvements to activities or interactions. *TQM*
 - Flow-wise improvements to process. *TQM*
 - Restructuring Roles. *TQM / BPR*
 - Realigning Organisational Structure and Process Structure. *BPR*

Point-wise improvements

- Reduce Cost
 - Which activities are candidates for improvement?
 - Where is quality controlled?
- Reduce Cycle Time
 - Simple Behaviour: CPA etc.
 - Complex Behaviour. Overhead for iteration, proportions for choice, complex analysis, e.g., Systems Dynamics.

Flow-wise improvements

- Increasing Parallelism.
- 80:20 rule. Generalist to Specialists.
- Planning for Success.
- Coherent Information Flow.
- State Changes.
- Customer Focus.
- Catch Faults Sooner.

Restructuring Roles

- Move activities between roles.
- Combine roles.
- Reduce the number of interactions needed to make the process work.

Restructuring Strategies

- Cohesion and Coupling.
- Concrete versus Abstract Models.
- Relax / Strengthen Approval.
- Specialists to Generalists (The Case Worker).
- Case management process & its description.
- Is everyone doing something useful?

- ‘A role should have high cohesion, that is the activities that form it should be closely related and collectively have a single purpose’. (Ould, 95).
- ‘As a set the roles should be loosely coupled, i.e. we should expect few interactions between them’. (Ould, 95).

- Concrete current model.
 - How things are done.
- Abstract current model.
 - Essence of what is done. The purpose or intent of the process. Often ignores implementation detail.
- New concrete model.
 - A better way to implement.
- Also examine: Subcultures, mechanisms & pervasive functions.

- Activities, Interactions and Events.
 - How the activity is done (mechanisms) versus the intent or purpose of the activity.
- Roles.
 - Who else might take the role?
 - Managing director or Approving Large Cash Outflow role.
- Need rules for moving from concrete to abstract roles.

Realignment

- Aim to reduce the cross functional flow.
- Examine Case - Case Clashes.
- Analysis of Interactions.
 - Categories of Interaction.
 - Warnings in Interaction.
- Deming's Tests of flow.

Categories of Interaction

- Five types of commitment.
- Assertive.
- Directive.
- Commissive.
- Declarative.
- Expressive

Warnings in Interaction

- Look for:
 - Pairs of roles with lots of fine-grain interaction.
 - Roles which have the same kind of interaction with many other roles.
 - Long concrete interactions.
- Do the activities / interactions add value?
- Does the checking etc. help achieve goals?

Deming's Tests

- Duplication.
- Illogical / Insufficient Sequencing.
- Complexity. Unclear Lines of Responsibility
- Opportunities for Error.
- Impact of Supplier Inputs.
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- Disconnects.

Hammer's principles of
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Hammer's Principles

- Organise around outcomes not tasks.
- Have those who use the output of the process perform the process.
- Subsume information processing into the work that produces the information.
- Link parallel activities instead of integrating their results.
- Put the decision point where the work is performed.

Measures (Metrics)

- The analogy with software.
 - Traditionally examined the products of development with heuristics.
 - Metrics adds a quantitative dimension.
 - OO Metrics currently still attempting to do this. E.g. metrics for OMT.
- Business, Strategic and Process Modelling is at the same stage,
 - i.e., models compared using heuristics.

- Aim to use measures to aid analysis of the static model.
- Need to be quantifiable.
- Need metrics to illustrate something about the process, not about the model.
- Consistency of abstraction.
- Validity. Theoretical and Empirical.

Measures for Point- wise Improvement

- Static: Frequency of case refinement thread dealing with errors.
- Dynamic: Proportion of cases taking each path.

Measures for Restructuring Roles

- Cohesion Metric?
 - ‘A role should have high cohesion, that is the activities that form it should be closely related and collectively have a single purpose’.
- Coupling Metric?
 - ‘As a set the roles should be loosely coupled, i.e. we should expect few interactions between them’.
 - ‘move activities...in order to minimise interactions’.

- Numbers of interactions in each category of commitment.
- Warnings / Guidelines. (Possible but vague).
 - Pairs of roles with a *lot* of fine-grain interaction.
 - Roles with *same kind of interaction* with many other roles.
 - *Long* concrete interactions.

Summary: Heuristics

- Any modelling method needs guidelines to aid creation and analysis of models.
- As with traditional analysis methods (e.g., Yourdon) we can discern guidelines (heuristics) for RADs.
- Some of these heuristics may be quantifiable. Hence counts could be used to aid analysis of models (especially static models).
- Consider: A RAD metric and its validation.

An Exercise: Creating Metrics

- You have been given a number of possible measures, on actions, interactions and control constructs.
- Evaluate these measures.
- Can you think of better ways to measure:
 - coupling & cohesion,
 - any other features.

Possible Measures: Actions & Interactions

- Interactions (multiple role count as ?)
- Actions
- Actions+Interactions
- **Cohesion**: $\text{Actions} / (\text{Actions} + \text{Interactions})$
- **Coupling**: $\text{Interactions} / (\text{Actions} + \text{Interactions})$
- Pt to pt interactions (multi role count each pr).
- Interactions / Pt to Pt Interactions
- Interaction squares inc. other roles.
- % Involvement in RAD interaction
- Driving interactions.
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- $\text{Driving} / (\text{Driving} + \text{Non-Driving})$
- $\text{Non-Driving} / (\text{Driving} + \text{Non-Driving})$
- Interactions which are pair-wise
- Interactions which include / are over n roles
- $\text{Pair-wise} / (\text{Pair-wise} + \text{others})$
- Av. Interaction Length: $\text{Int Squares} / \text{Interactions}$

Possible Measures: Control Constructs

- Number of Choices
- Number of Choice (Case Refinement) Threads
- Number of Parallel
- Number of Parallel Threads
- Threads which iterate for quality checking.
- Choices / (Actions+Interactions)
- Choice Threads / (Actions+Interactions)
- Parallel / (Actions+Interactions)
- Parallel Threads / (Actions+Interactions)
- Checking / (Actions+Interactions)

Selected papers

- *These ideas of taking heuristics and then using measures to aid analysis of processes have coupled roles have been applied to a number of industrial processes and described in the literature. E.g.,*
- *Phalp, K.T., and Counsell, S.J., (2001), Coupling Trends in Industrial Prototyping Roles: An Empirical Investigation, The Software Quality Journal, volume 9, issue 4, pages 223-240, December 2001.*
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- *Latterly:*
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Summary (again)

- Examined heuristics for RADs
- Considered how these might also be turned into measures
- Suggested some measures (and noted impact of a coupling metric for RAD) and how this spawned much further work.
- What about model quality more generally.
- For example, what would this mean for use cases, or designs, or specification in general? (see Comprehension Revisited)
- How could we try to improve, or ensure the quality of our models?
- What inspections processes might be apply?
- How does this differ in purpose from business models to spec or design (hint: some models evolve to become code).

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- We have tried out Role Activity Diagrams – at the same time discussing other aspects of the analysis – noting issues and finding improvements.
- We have discussed issues in moving from process model to specification – and examined different proposed solutions.
- *Now consider how the model can be used within the analysis task.*
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Most interested in Restructuring Roles (BPR/Strategic modelling).

- Reduce Cost
 - Which activities are candidates for improvement?
 - Where is quality controlled?
- Reduce Cycle Time
 - Simple Behaviour: CPA etc.
 - Complex Behaviour. Overhead for iteration, proportions for choice, complex analysis, e.g., Systems Dynamics.

Reduce Cost

Which actions are candidates for improvement?

Annotate RAD with resource usage for actions / interactions.

Look for those of high cost, which will give the biggest benefits.

Examine case refinements concerned with checking quality.

Find the frequency of following the thread which deals with errors, find out where fault was introduced. What can be done to change this? *** Measure Alert ***

1.2 Shorten Cycle Time

Critical Path Analysis

Try to shorten activities on the critical path.

Look for reducing variability, improving reliability of activities, on the critical path with large variance in duration.

Complex Behaviour

For Loops: try to add in an overhead which accounts for the iteration.

For Case Refinement (Choice). Add proportions to alternative paths.

*** Dynamic Measure Alert ***

OR

Systems Dynamics Approach..

States become Stocks

Actions / Interactions Become Flows

Case Refinement / Choice: Split flows whose rates sum to one.

Part Refinement / Parallel: Joint flows, material replicated in each flow.

- Increasing Parallelism.
- 80:20 rule. Generalist to Specialists.
- Planning for Success.
- Coherent Information Flow.
- State Changes.
- Customer Focus.
- Catch Faults Sooner.

2.1 Increasing Parallelism: Increase the overlap between activities. (especially those on the critical path).

2.2 80:20 rule Generalist to Specialists. Does every case need to go through the same process. E.g. Trant, do we always need the order form. Elaborate the action,. e.g. approval into a choice of two paths. Can separate the special cases and give to a smaller group of specialists, allowing general cases to be dealt with by a less skilled group (or role).

2.3 Planning for Success. Will shorten elapsed time at the expense of extra resource.

Originally: Do A, decide whether to continue, and then if OK do B.

Replace with: Do A and Do B, until having completed A we either continue or scrap both.

Therefore there is more potential waste but greater speed.

2.4 Coherent Information Flow. Use interactions annotated with information flow.

Is all information produced needed?

Is information produced before it is needed?

Is all data / stuff used by the receiving role?

2.5 State Changes . Check the state changes are consistent for an ELH. Our annotated state models do this.

2.6 Customer Focus. Classify actions / interactions as:

1. Delivers value directly to the client of the process.

2. Delivers value only to the organisation.

3. Waste of some form. E.g. quality control, exception handling, error handling, ...

Type 1 should be on the critical path.

Type 2 of the critical path.

Type 3 to be reduced / eliminated.

2.7 Catch Faults Sooner. Can faults be detected sooner?

- Move activities between roles.
- Combine roles.
- Reduce the number of interactions needed to make the process work.

- Cohesion and Coupling.
- Concrete versus Abstract Models.
- Relax / Strengthen Approval.
- Specialists to Generalists (The Case Worker).
- Case management process & its description.
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3.1 Cohesion and Coupling of a Set of Roles

3.2 Concrete versus Abstract Models

3.3 Relax / Strengthen Approval

Question the approval and authorisation mechanisms.

3.4 Specialists to Generalists (The Case Worker)

NB. This is the opposite idea to that of 80:20 Generalists to Specialist idea on activities, but applied to roles. This was the main idea behind the GISIP Case Handling process being re-engineered to produce multi-disciplinary case handlers.

When a case or gram moves from one role to another, causing an interaction, we often find a buffer where roles interact. The roles process their work at their own cycles, but must interact synchronously, and therefore some way is needed to decouple the cycles at this interaction. Typically these concrete buffers are in-trays, folder, e-mail etc., but they still break up the work, cause delay, hamper tracking and monitoring.

3.5 Is there a case management process?

Where is it described?

3.6 Is everyone doing something useful?

Roles which are only third parties, have few or no activities of their own, add no value, introduce delay, and so on. Note the NatWest Benefits Management Group Role.

- ‘A role should have high cohesion, that is the activities that form it should be closely related and collectively have a single purpose’. (Ould, 95).
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Contrast with Software Engineering Definitions.

- Concrete current model.
 - How things are done.
- Abstract current model.
 - Essence of what is done. The purpose or intent of the process. Often ignores implementation detail.
- New concrete model.
 - A better way to implement.
- Also examine: Subcultures, mechanisms & pervasive functions.

Identify other sub-cultures.

Functions which act as mechanisms for interactions / carrier functions

Functions that act throughout the organisation / pervasive functions

- Activities, Interactions and Events.
 - How the activity is done (mechanisms) versus the intent or purpose of the activity.
- Roles.
 - Who else might take the role?
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Rules

1. Produce concrete as-is process model.
2. Identify abstract roles. Group activities and decisions into abstract roles.
3. Identify ways to move activities and decisions from the abstract roles into the concrete roles in order to minimise interactions. *** Measure Alert ***
4. Redefine the concrete roles.

- Aim to reduce the cross functional flow.
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- Five types of commitment.
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Categories of Interaction

Five types of commitment in interactions. Can we collect against these categories?

*** Measure Alert ***

Assertive - Noting a state of affairs. Roles being informed about the completion of something. Do they need to know? They may get the copy and bin it.

Directive - Asking another / others to do something. Each role should do something as a result, and later reporting back an assertive commitment (interaction).

Commissive - Committing to do Something. Should therefore be a later interaction (assertive) to say that it is done.

Declarative - Bringing about a new state of affairs. All roles see this as a trigger to get on with some new activity, it gives them permission (check they know what to do).

Expressive - Not within our scope.

- Look for:
 - Pairs of roles with lots of fine-grain interaction.
 - Roles which have the same kind of interaction with many other roles.
 - Long concrete interactions.
- Do the activities / interactions add value?
- Does the checking etc. help achieve goals?

Look for:

Pairs of roles with lots of fine-grain interaction. Indicates poor division of activity or confusion over objectives. *** Measure Alert ***

Roles which have the same kind of interaction with many other roles. May be a need for a pervasive function. *** Measure Alert ***

Is the concrete form of the interaction 'long'. *** Measure Alert ***.
This may cause delay. Does the concrete form of the interaction have a buffer. Causes delay, may reveal a carrier mechanism., which could be separated (pervasive) removed our automated.

Do the activities / interactions add value?

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Note we could use simulations (similar to RoEnact) to collect such metrics, or we could examine real processes.

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- Expressive - Not within our scope.

Warnings in Interaction

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- Parallel Threads / (Actions+Interactions)
- Checking / (Actions+Interactions)

Collected Measures

Bournemouth
University



SoSyM

A large grid of empty cells, likely for data entry or analysis, covering the majority of the page's content area. It consists of approximately 20 columns and 100 rows of small squares.

www.sosym.co.uk

Introduction to Requirements Engineering

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