Talking Points for the Historic Railway Accidents

General idea of the exercises is to bring out

- the *importance* of considering perception, privilege and protocol when analysing behaviour of systems of interacting agents

- the *complexity* of the issues relating the behaviour of systems of interacting agents to their perceptions, privileges and protocols

You aren't expected to arrive at LSD specifications, but to explore the nature of the agents, their oracles, handles and privileges and consider what considerations would link these with the actual system behaviour. In general, the main thrust of my agenda is on why an accident is explicable, not on what would have prevented it happening.

A general theme is can you make models that express the activity of agents in ways that have a generic, rather than highly particular, application? This seems to be part of what went on in the ritualisation of procedure and knowledge that accompanied the rationalisation of railway practice.

Historic Railway Accidents 1

Your agenda:

a. analyse the perceptions and privileges of the agents involved

Your agents will include K, B, train drivers, the signal, the alarm, the clock, the telegraph etc. You should first classify these as observations using LSD.

b. discuss the role of knowledge (interpreted perception) in the events

There are some extraordinary examples of relevant knowledge: e.g. K needed to know *whether S had seen the red flag*. A relevant question here is: in what way is such knowledge different in kind from the stationmaster's knowledge that a train is ready to depart, which plays a (relatively secure) part in a useable protocol?

c. what relevance has the mode of operation of the telegraph?

Typically it matters greatly how an oracle is observed and updated. In animation, we need to consider the fact that K and B registered the status of the tunnel by detecting state-changes in the needle that didn't persist and whose observation wan't necessarily acknowledged.

d. what is the role of the automatic signal device?

Malfunction of the automatic signal affects the perception of the 2nd driver in a way that's crucial in the sequel.

e. to what extent is time an important factor in the accident

Close running trains call into question the independence of the telegraph signals for B. Timing of observations at far end of tunnel relates to length of tunnel also.

What recommendations would you make for avoiding a recurrence?
What agents do you consider primarily responsible for the accident?

Is it possible / appropriate to write an LSD specification for the agents?
If so, what insight can be gained from this?

The actions of K and of S in reversing his train can perhaps be modelled, but the nature of the knowledge their actions reflect is much too specific to the particular context of the accident to be of general use in framing a safe protocol.

Historic Railway Accidents 2

This looks the most promising example for LSD analysis

Your agenda:

a. analyse the perceptions and privileges of the agents

Principal agents are H and E and the train driver, but the signals are also significant in the concurrency. Is it possible that H and E were supposed to be able to see the points and signals on their side of the station? Presumably they couldn't at night.

b. what role does time play in the accident?
c. where is knowledge (interpreted perception) involved?

For H and E, knowledge about what train is next is based on observation of the train schedule and perception of time.

d. what are the most significant environmental factors?

Lack of visual communication, possibly the fact that it was dark. Absence of any means of communication between the boxes.

e. would redistribution of privileges between boxes have helped?

One signalman each line perhaps, but then why two signalmen at all? Most other arrangements (N box has N signals and points etc) look pretty dangerous.

f. what interlocking would have helped?

Synchronise the points to platform loop with distant signal would have been better.

g. had there been a telegraph, what communication was necessary?
h. what assumptions about scheduling could have guaranteed safety?
i. would you hold anyone responsible for the accident?

I think there's something fundamentally odd about this accident. If the signalman had no knowledge about trains except from the schedule, how were they meant to cope with changes? Had there merely been a change to the schedule, due to the (uncommunicated) breakdown of the goods train preceding the mail, the same scenario could have arisen through arbitrary assumptions on the part of the signalman. On this basis, I don't see at what stage H would have been justified in resetting the up line to clear.

Can you devise an LSD specification for the signalmen agents?
Can you model the interlocking arrangements as dependencies in EDEN?

Historic Railway Accidents 3

Sonning

a. accidents of this nature were commonplace before continuous brakes were developed, and would have probably have been less serious has continuous braking been in operation. The inquiry commented on the absence of spring buffers between third-class carriages.

   How would the nature of the braking mechanism and the connection between carriages be reflected in an LSD specification of the agents involved?

   An operational analysis here would be very difficult, but the idea is to consider communication between wagons vs independent behaviour. Note also the role of the landslide as super-agent.

Burnley

b. What are the principal agents that are acting in the critical moments leading up to this accident? Can we express their interaction in LSD? How should we express the fact that TB can operate the East Lancs Points and the loco shed points, but can't operate both at once?

   Carriages and points as well as drivers and TB have a critical role in this. The autonomy of points and carriages is striking. (Perhaps you only need gravity for both carriages and points.) Interaction looks plausibly related, but note the nature of the communication between TB and the points. Probably need to invoke role switching for agents to express the way in which points and TB behave. TB can't act in two roles at once.

c. To what extent can the evolution of interlocking lever mechanisms for distributed control be modelled by definitive principles?

   Point at issue here is that centralisation of levers into frame evolved from problems of distributed control of physically separated points. This makes parallel execution of two roles in point operation possible.

Menheniot

d. Why was there an accident?

   Both guards were called Dick, and the wrong train pulled off.

e. In what respect was the signalling inadequate?

   There were starting signals.

f. Discuss the nature of observations we would need to represent this incident using LSD.

The incident shows the power of reference, another aspect of knowledge: the guard on the up train believes himself to be the Dick in question.

Historic Railway Accidents 4

Your agenda:

a. Analyse the roles and protocols of stationmaster Sproule, inspectors Cooper and Parker, clerk Robson.

The idea here is to express authorisation to act using suitable protocols.

b. Could you handle the concept of delegating authority in LSD?
c. Who was the inspector on duty at 9.23pm?

There's a very subtle appeal to delegated authority in the actions of the day inspector, who presumably was not actually on duty. This would have to be modelled as though P were a subagent of C, but the modelling looks to be too particular to this accident to be the basis of a sensible protocol.

d. Is Cooper's "No certainly not" justified?
Discuss C's position with reference to commitment to action in LSD.

The issue of when an agent is committed to exercise a privilege is fraught with problems in operational terms. Consider: I commit myself to opening the door, but before I do some-one locks it for instance. It would appear that C was not authorising an instruction to R despite his form of words.

e. Discuss the nature of the assumptions made by one agent of another in the events leading up to the departure of the Express.

Critical assumptions: C assumes R won't send the message unauthorised? P assumes that C has no grounds of uncertainty about the status of the Mail.

f. Discuss R and C's perceptions of their actions at the inquiry.

Of interest is R's confession that *he never did such a thing before in his life*. This is important in the context of *ritual* as a mode of transforming perception into knowledge ("we understand the following by these symbolic actions"). Had C been in the habit of giving verbal instruction to R that he fully expected R to act on (contrary to

strict working practice), this would put a different perspective on the whole matter.

In the light of the above issues, is there any prospect of using LSD

- to model the interactions leading up to the departure of the express
- to model these interactions and R and C's responses at the inquiry.

This looks pretty hairy to model in LSD either way. The point of interest here is that agent-oriented modelling does offer some prospects for modelling inconsistency, such as is explicit in R and C's testimony.

Who would you censure most for the accident?

Historic Railway Accidents 5

Your agenda

a. What are the protocols and privileges of the various agents as laid down by regulation?
b. What are the protocols and privileges of the various agents as exercised in practice?

The curious thing about this accident (reflecting its association with a more sophisticated stage of railway development) is that the relevant protocols are tantalisingly simple. [Cf the verbal communication between agents in the previous case study.] ... even if all 4 agents adopt the same privileges with respect to Tyer machine operation.

c. Analyse the knowledge each agent has at each stage as the events occur.
d. Analyse the knowledge that each agent should have had at each stage.

I envisage that some interesting tables could be drawn up to represent this knowledge in both scenarios. Notice that here the knowledge element (where is the express, where is the stopping train etc) is remarkably simple (cf some of the accidents of the previous century above). It only gets to be more complicated when issues such as *is this the MA-tablet or the NA-tablet?* become crucially significant.

e. Analyse the assumptions the agents make in their communication.

The crux of this disaster seems to be in the hidden *I know what you know* and *I know what you are doing* assumptions. The stationmaster assumes that T has exchanged the token, T assumes that the stationmaster knows the express is on its way, J assumes the express is delayed etc etc. Notice how physical actions, both ritual and functional, such as *putting the tablet in the Tyer instrument,* and *setting the points for the express* serve to communicate knowledge in a consistent way. A curious aspect of such ritual is that it induces interactions that subvert

perception, so that the stationmaster and the driver don't bother to *look* at the tablet.

f. Analyse the role that spatial distribution of agents plays in the events.

Distribution of knowledge by agent as in c and d can somehow be correlated with knowledge of agent by location. (Incidentally of interest how many agents were necessary to cause the required distribution of knowledge for this accident to occur.)

g. Can you work out what interlocking – recommended by the inquiry – would have prevented this accident? Would that have been foolproof?

The starting signal should have been interlocked with the Tyer instrument. I can't see the scenario where it would fail, but I would find it even more convincing if a starting signal actually physically stopped a train.

h. What would have been the implications had the crew of the Express not been able to recover the MA-tablet?

The purpose of this question was to draw attention to how the consequences of automatic procedures have to be viewed against perturbations of the system that take account of failure conditions if possible. I don't know at what stage the breakdown train would have arrived had the MA-tablet not been recovered.