Accomplishing 'Just-in-Time' Production

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Abstract: We present an ethnographic study of work in the control room of a manufacturing plant. While work in the plant is oriented towards a very strict production orthodoxy and is to large degrees automated, we find that the overall dependability of the plant is not so much the outcome of careful planning that has gone into the design of the production management system. Rather, it is a situated accomplishment resulting from the work of competent members going about their everyday activities, which are oriented towards and made accountable through the production orthodoxy as opposed to being determined by it.
Keywords: production management, situated accomplishment

ENGINECO: The Boundaries of Planning and Control

We present findings from an ethnomethodologically-informed ethnographic study (Hughes et al 1995) of work in ENGINECO, a manufacturing plant producing mass-customised diesel engines. We illustrate some of the working practices of Control Room workers as they attend to the contingencies of production management and control. The findings support a contingent view of production planning and scheduling, leading us to argue that the implementation of production plans is always a practical and situated activity, the character of which emerges in action. The contingent view emphasises the incompleteness of knowledge and the set of circumstances - more or less intended, arbitrary, uncontrolled or unanticipated - that affect action (Dant and Francis 1998). In contrast to the rationalist view, the implementation of a production plan is a production worker's formulation, produced in response to issues concerning the 'local logics' of day-to-day production management. This points to the dynamic yet situated nature of knowledge and plans, the "minor actions, minor decisions and minor changes", upon which the organization rides (Boden 1994.). That is to say, local logics attend to the incompleteness of knowledge on both organizational and spatial-temporal levels - that which is an acceptable solution *just here and just now* with these circumstances and in this organisational context is a basis for proceeding *right now*. Decisions are made in the fabric of both real space and time which as Boden notes "is (...) an accountable matter (...) open to appraisal, revision, condemnation (and) repetition", (*op cit*, p. 192). This stands in marked contrast to the rationalist view of planning where plans stand as directives - 'scripts for action' - for future actions produced out of a systematic analysis of the possible options and constraints on their application.

Normal, Ordinary Troubles of Production

The production environment at ENGINECO is shaped according to a just-in-time (JIT) production orthodoxy centred around the notion of the 'buildability' of an order which needs to be guaranteed before production can start. The management of production should not, however, be read as the straightforward instantiation of a plan but rather it is a situated accomplishment that invokes the spirit rather than the letter of 'buildability' (Voß, Procter, Williams 2000). While one might not want to say that the concept of JIT has been abandoned, it has certainly been appropriated to local contingencies such as scarce material or inadequate performance of the logistics system. Control room workers have taken over some responsibilities from assembly planning regarding the management of orders and material and they may well schedule orders for production although material is still on its way to the plant. So, while originally buildability was a relationship between the order with its bill of material and the inventory, now it involves a judgement made by control room workers about how 'things will work out'. The above discussion points to some of the worldly contingencies that Control Room workers routinely deal with as a part of their planning and scheduling work. More precisely, all plans are contingent on "situated actions" (Suchman 1987). We found a series of expectable or ordinary troubles whose solution is readily available to members in and as a part of their working practices. That is, such problems do not normally occasion recourse to anything other than the usual solutions - where a problem contains within it a candidate (used-before-and-seen-to-work) solution. These problems and their solutions are normal and natural in and as a part of everyday work invoking a search through a series of seen-to-work-before repertoire of candidate solutions.
This does not mean that any old behaviour will fit as a candidate solution. The worker facing a problem

draws upon a repertoire of candidate solutions and thereby makes themselves accountable as having done this or that (this might also be a way of making later actions (such as placing the problem in the complaint book or calling in an engineer) accountable - having tried all the usual solutions one has the 'right' to call on others to attempt to remedy the problem and one is accountable in this manner "I have tried this and that but they did not work, therefore I have done this".

Dealing with Unexpected Troubles

Problems not susceptible to these remedies also demand a solution – workers cannot remain indifferent to their presence – but by definition that solution is not a normal or usual one. In order to keep production running, workers have to find and evaluate possible solutions quickly, taking into consideration the present situation, the resources presently available, as well as, ideally, any (possibly long-term and remote) consequences their activities might have:

From fieldwork notes: *A material storage tower went offline. Material could be moved out of the tower to the line but no messages to the Assembly Control Host were generated when boxes were emptied. Control Room workers solved this problem by marking material in the tower 'faulty' which resulted in new material being ordered from the logistics provider. This material was supplied to the line using forklift trucks. […] A material requirements planner called to ask why so many parts were suddenly 'faulty'.*

Such situated problem-solving results in workarounds that are initially specific to the situation at hand but may become part of the repertoire of used-before-and-seen-to-work candidate solutions. They may be further generalised through processes of social learning as workers share the various 'local logics' with colleagues or they might in fact get factored into the larger socio-material assemblage that makes up the working environment. This process of problem solution and local logics, however, is critically dependent on members' orientation to the larger context, their making the solution accountable to colleagues and their ability to judge the consequences. The following fieldwork material illustrates how problem solutions can get factored into ongoing development of the production management system as well as how they can adversely affect the success of the system:

From an interview with one of the system developers: *[Such a complex system] will always have flaws somewhere but if the user has to work with the system and there's a problem he will find a work-around himself and the whole system works. [...] The whole works, of course, only if the user really wants to work with it. If he says: "Look, I have to move this box from here to there and it doesn't work. Crap system! I'll let a forklift do this, I will not use your bloody system" then all is lost. Then our location information is wrong […] then it will never fly. [If they come to us and say] that something's not working, we will say "oh! we'll quickly have to create a bugfix and, for the moment, I'll do this manually without the system", then it works, the system moves on, everything stays correct, the whole plant works and if the next day we can introduce a bugfix the whole thing moves on smoothly.*

This bears on the possibility of offering a fully automated solution to planning and production management. It is difficult to see how one could solve unexpected problems in an automated manner. Human intervention (and resourcefulness) is required to find and implement a solution to the problem. But the boundaries between the types of problem are semi-permeable. Members will view different problems in a variety of ways and this may lead to the resolution for the problem through the ability to recognize some kind of similarities inherent in this and a previous problem through the phenomenon of organizational memory (Randall et al 1996). As in other collaborative work (see e.g., Hartswood and Procter 2000), members are aware of, and orient to, the work of their colleagues. This is supported by the affordances of their socio-material working environment as the following example illustrates:

From a video recording of Control Room work: *Oil pipes are missing at the assembly line and Jim calls workers outside the Control Room to ask if they "have them lying around". This is overheard by Mark who says that: "Chris has them". He subsequently calls Chris to confirm this: "Chris, did you take all the oil pipes that were at the line?" Having confirmed that Chris has the oil pipes he explains why he thought that Chris had them: "I have seen the boxes standing there".*

Here, the visibility of situations and events on the shop floor leads to Mark being aware of where the parts in question are. The problem that the location of the parts was not accurately recorded in the information system was immediately compensated by his knowledge of the shopfloor situation. Likewise, Jim's

knowledge of working practices leads him to call specific people who are likely to have the parts. Mark's observation provides him with a shortcut, making further telephone calls unnecessary.

(continued) *Since it was first established that parts were missing, production has moved on and there is the question what to do with the engines that are missing oil pipes. Jim and Mark discuss if the material structure of the engine allows them to be assembled in "stationary assembly".*

Workers in the plant are aware of the material properties of the engines produced and are thus able to relate the material artefact presented to them to the process of its construction. In the example above, Mark and Jim discuss this relationship in order to find out if the problem of missing oil pipes can be dealt with in stationary assembly, i.e., after the engines have left the assembly line. They have to attend to such issues as the proper order in which parts can be assembled as well as, for example, the physical orientation of the engine as some parts can only be assembled when the engine is positioned accordingly. Turning engines can only be done with heavy equipment available at the assembly line. The knowledge of the material properties of engines also allows members to detect troubles, i.e. the product itself affords checking of its proper progress through production (cf. Hartswood and Procter 2000). In her discussion of decisions and decision-making Boden (1994) suggests that classical theoretical treatments often confound our understanding of these organizational phenomena, suggesting instead that decision-making is located in fine-grained, sequential organisational activities. Of particular relevance is the notion of 'local logics': *"As they sift through locally relevant possibilities (...) social actors use their own agendas and understandings to produce 'answers' that are then fitted to 'questions'* (Boden 1994).

Conclusions

Our study shows how local logics are deployed to provide 'routine' but nevertheless skillful responses to both expected and unexpected 'normal natural troubles'. Underlying mainstream work on production planning is the notion of uniform and predictable prescriptions of activity. In contrast we document working practices that attend to the 'worldly contingencies' of production, the 'normal, natural' troubles whose 'usual' solution is readily available in and as part of everyday working practice. We document such problem solving 'from within' detailing the production of workarounds that may themselves become part of the repertoire of candidate solutions.

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Acknowledgement: The research reported here is funded by the UK Engineering and Physical Sciences Research Council (award numbers 00304580 and GR/N 13999). We would like to thank the staff at the case study organisation for their help.