# Production Management and Ordinary Action: An Investigation of Situated, Resourceful Action in Production Planning and Control

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## An investigation of situated, resourceful action in production planning and control

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## Abstract

We present a study of production planning and management in the Control Room of a manufacturing plant producing mass-customised diesel engines. The study illustrates how these activities are subject to various 'worldly contingencies' and how the production process emerges from the situated and resourceful activities of various kinds of professionals in the plant. These observations have serious implications for the question of how the various kinds of "intelligent manufacturing systems" that have been devised can be employed. While the plant studied uses various kinds of automation systems, it critically depends on situated and resourceful action. We contend that for any kind of production management technology to be successful, it has to build on the everyday working life experiences of those working in production environments. This implies re-conceptualising IT systems design and development to support evolutionary processes through 'design-in-use'.

## Introduction

A decade ago we studied the development and implementation of the predecessors to contemporary production management systems [WW93, FWW90, CW97]. These Computer Aided Production Management (CAPM) systems were strongly promoted by technology suppliers as a means of reducing stock and work in progress, improving flexibility and avoiding late deliveries. However, in a large proportion of cases, these software systems failed (i.e., were abandoned), or did not deliver these expected outcomes.

We found that supplier offerings embedded organisational presumptions about the production and informational setting, often rooted in the large, predominantly US aerospace and vehicle manufacturers in which they had originally emerged, that did not match those of the firms to which they were now being introduced. For example, in UK manufacturing firms, production management practices were based upon judgement rather than formal criteria. As a result of the discrepancy between technical presumptions and organisational reality these complex and allegedly ‘integrated’ solutions were abandoned or only partially implemented or rejected in favour of simpler, locally-developed solutions. It proved necessary to reconfigure the packaged solutions to get them to work in these new contexts. We described as ‘innofusion’ this local innovation effort, in the struggle to get systems to work in the course of their implementation and use, through which generic supplier offerings were adapted to the particular productive circumstances of organisational users [FWW90].

Today, integrated solutions such as Enterprise Resource Planning (ERP) are again being strongly promoted with the promise of organisational improvement and the achievement of best practice. The earlier problems with CAPM are, it is claimed, overcome, for example by libraries of options that can cater for the full range of business processes and organisational circumstances. Some cautionary notes have been sounded regarding the high costs and risks of aligning organisations to embedded organisational presumptions, though the difficulties of customising standard solutions has created a tendency to accept the power of default [Koc97, PC01].

While the aims of the new generation of CAPM systems have pretty much stayed the same – e.g., reducing slack times, reducing inventories, improving productivity, quality, and control – the conditions and means have changed. The first and second wave of production management technologies were mostly concerned with collecting enough real-time operational data to establish centralised control. Recent developments, however, have shifted focus more towards (inter-) organisational integration and the development of various kinds of ‘intelligent manufacturing systems’ to address problems in production planning and scheduling.

Underlying these developments is a shift in the type of production addressed. While early systems were aimed at mass-production of similar products, today there is a move towards flexible production systems that can be reconfigured rapidly and towards mass-customisation, the large-scale manufacture of customised products [SBF01]. Information systems play a crucial role in this transformation. It is against this backdrop that we present findings from an empirical study of work in a manufacturing plant producing mass-customised diesel engines. Through extracts from fieldwork, we illustrate some of the working practices Control Room workers are involved in as they attend to the contingencies of production management and control. Finally, we discuss some issues we see arising in relation to production management systems.

The findings support a contingent view of production planning and scheduling, leading us to argue that the implementation of production plans always calls for practical and situated activities whose character 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 [DF98]. In contrast, the rationalist view has it that plans stand as directives for future action, produced out of a systematic analysis of the possible options and constraints on their application which can then be passed on for implementation as schedules for production to be followed literally as a ‘script for action’. As we will see from our studies below, this is not the case. 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.

Figure 1: A Control Room worker monitoring the production process.

## The Case Study: ENGINECO

The case study organisation, ENGINECO, is one of the largest independent manufacturers of diesel engines worldwide. The plant studied produces mass-customised diesel engines with power outputs ranging from 11 to 190 kW. Production in the plant was designed to work to a strict production orthodoxy and large parts of it are automated. Since the plant was built in the early 1990s, significant changes have been made to keep up with changing customer demands and to keep the plant operational in a difficult economic environment. An ethnographic study of working practice and how it is re-negotiated in this context was conducted [VPW00]. Part of the aim of this work has been to contribute to the ongoing development of information systems in the Control Room (Figure 1).

The ethnographic method is dedicated to observing in detail everyday working practices and seeks to explicate the numerous, situated ways in which those practices are actually achieved [HKRA95]. Interviews with staff were recorded, and notes made of activities observed and artefacts employed. The data also includes copious notes and transcriptions of talk of 'members' (i.e., regular participants in the work setting) as they went about their everyday work. Ethnography is attentive to the ways in which work actually 'gets done'; the recognition of the tacit skills and cooperative activities through which work is accomplished as an everyday, practical activity and in making these processes and practices 'visible'.

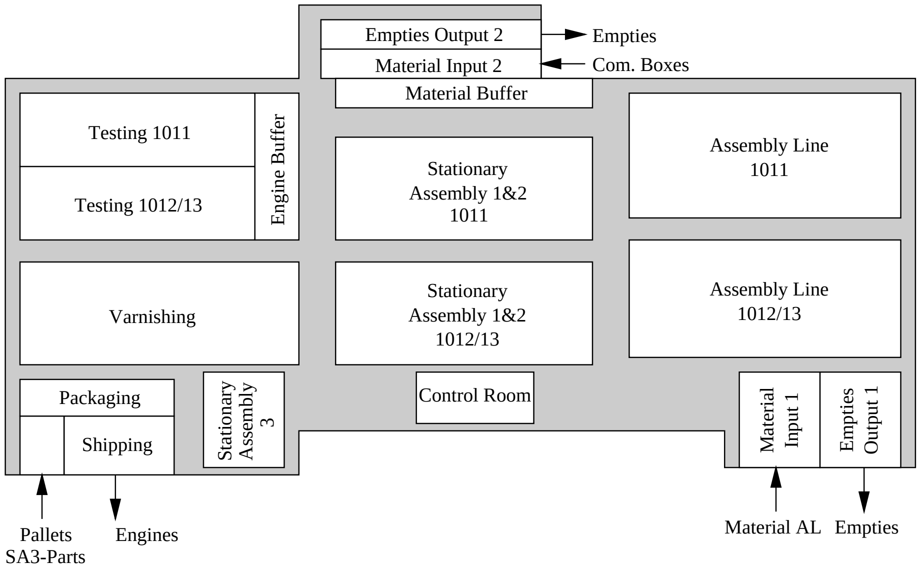


Figure 2: The production layout of ENGINECO's plant (in 1999).

## The Permeable Boundaries of Planning and Control

As noted above, the production environment at ENGINECO is shaped according to a particular just-in-time (JIT) production orthodoxy. Material is delivered to an external logistics provider that operates a high-shelf storage facility in the plant on ENGINECO's behalf. Upon ENGINECO's order, the logistics provider delivers parts to the plant. The picking of parts for individualised engine configurations is also subcontracted to the logistics provider. Consequently, the plant itself was not designed to store large numbers of parts, containing buffer spaces for only four hours of production. The layout of production is basically linear, with an engine picking up its component parts as it moves from one side of the plant to the other (see Figure 2). The production of engines is divided into two main steps: the basic engine is produced on an assembly line while customer-specific configuration is done in stationary assembly workspaces.

Various IT systems are used to plan and control the production process in the plant (Figure 3). Central to production is the Assembly Control Host that controls all processes within the plant. It is linked with local systems in the various functional units of the plant (e.g., assembly lines) as well as with the company's ERP (SAP/R2) system from which it receives production orders and to which it reports on progress made in the production process. When the Assembly Control Host is ready to begin executing a production order, the material required is ordered from the logistics provider and instructions are sent to relevant assembly line control systems which, in turn, interact with the production equipment (e.g., robots). Further exchanges are necessary as production is underway, e.g., to effect transportation of materials and update inventories. In principle, then, production management is virtually automatic.

Strong emphasis is placed on asynchronous operation of the various IT systems for a number of reasons: to decouple systems, thus making the overall

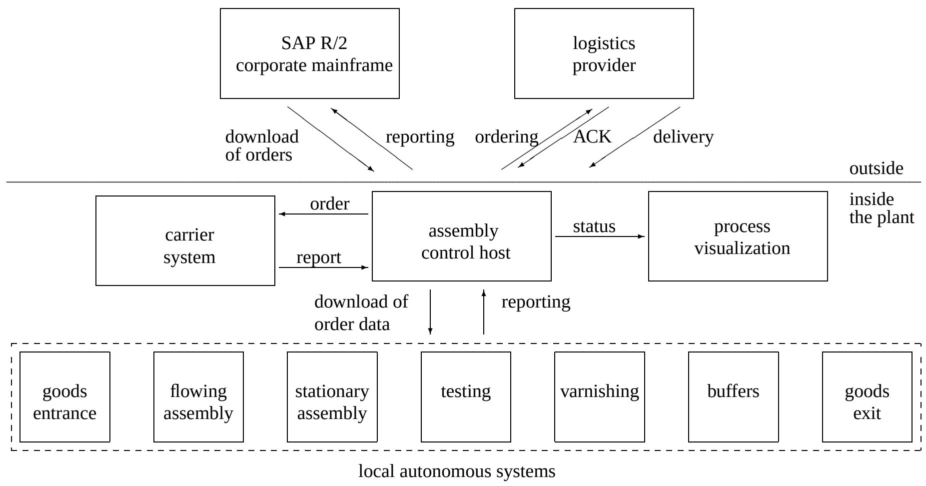


Figure 3: IT systems in, and relating to, the plant.

assembly more reliable, to facilitate changes, and to reflect the fact that they are developed and controled by different actors (ENGINECO itself or external providers). The Assembly Control Host is custom-built rather than being part of the ERP system. It has been developed and is now operated and maintained by an external IT service provider which has personnel situated in the plant.

A basic precondition for production to work along the lines of the JIT regime described above is that all parts are available in time for production. This notion of *buildability* is the key concept in the production management orthodoxy at ENGINECO. Located within the plant, an assembly planning department is responsible for the buildability of engines, assuring that all component parts as well as the various pieces of information needed (such as workers' instructions) are available before production starts. They are also responsible for scheduling production orders in time to meet the agreed delivery dates. A simple heuristic is used within the ERP system to establish a preliminary schedule, optimising usage of the testing field which contains some of the most expensive equipment and, in contrast to the assembly line, is heterogeneous in that different testing stations are needed to accommodate different engine types. Taking into account their knowledge about the current status of the plant, upcoming events, and the requirements of Control Room workers, assembly planners then modify the schedule before downloading assembly packages (collections of production orders) into the Assembly Control Host.

Given the strategically planned capacity plan and short term production plan as well as the (predicted) availability of customer orders, assembly planning plans production in decreasing timeframes – up to 6 months, up to 8 weeks, up to 3 weeks, and daily production packages – with increasing detail. Throughout all planning steps, the activities of capacity planning, scheduling of orders, and material acquisition take place. Daily production packages are supposed to be compiled with a lead time of one or two working days, enabling the timely scheduling of material and creating a buffer of spare orders for production in case some orders cannot be built because of breakdowns.

The creation of production packages is the effective interface between the assembly planning department and production, which is supervised by Control Room workers (see Figure 1). According to the orginal plan, Control Room workers can work under the assumption that all the engines they have to deal with are 'buildable'. However, because of problems with the availability of certain parts, especially crankcases and because of ever increasing customer demands, the notion of buildability was renegotiated in order not to let the plant fall idle. Today, there are 'green', 'orange', and 'red' engines in the plant that are respectively: strictly buildable, waiting for a part known to be on its way, or waiting for something that is not available and doesn't have a delivery date. Control Room workers have effectively taken over the ultimate responsibility of ensuring that engines are buildable. Because the majority of engines are 'green' and because the assembly planning department ensures that only few parts are missing for 'orange' and 'red' ones, this renegotiation was possible without changing practices to the point where the production orthodoxy would have broken down. In practice, engines that are introduced into the plant's Assembly Control Host from the company's ERP system can change their status in all directions: 'red' engines will eventually become 'green' but occasionally, a 'green' one becomes 'red', e.g., when inventories are corrected to account for parts that are defective or have gone missing. The following extracts of fieldwork material illustrate how Control Room workers have taken over some responsibility for planning and scheduling:

> **From the shiftbook:**
> As soon as crankcases for 4-cylinders are available, schedule order number 56678651 (very urgent for Company X).
> Engines are red even when only loose material is missing.

In the first example, 'orange' orders have been downloaded from the ERP system to the Assembly Control Host and Control Room workers have to ensure their buildability before production can actually start. They effectively assign material to orders and may thus have to decide which batch of 4-cylinders awaiting assembly to schedule first. Given the information that order number 56678651 is very urgent, they will give priority to these engines. The second example refers to a problem with the IT systems which does not allow them to start production of engines which are missing loose material (e.g., manuals). Clearly, while a missing crankcase effectively prevents production of the engine, loose material is not needed until the engine is actually shipped to the customer (and perhaps not even then in very urgent cases). Whereas assembly planning schedules production orders, i.e., batches of engines with similar configurations as ordered by a customer, Control Room workers deal with individual engines. They are also much closer to the shopfloor and take into account the interests of members there, for example avoiding a long string of potentially problematic engines, e.g., ones that need more work than others and would affect their engines per hour performance target.

By redefining details of the organisational division of labour, EngineCo has effectively addressed a situation that was impossible to predict during the original planning of the plant. This is not to say that the notion of buildability has ceased to exist and has been replaced. Rather, the general notion as originally inscribed in working practices has, by appropriation, been localised to take into consideration the 'worldly contingencies' – situations which arise in and as a part of the everyday work of the plant and its members and which are not, for example, involved with setting up a new system or introducing new machinery or practices – of production in ENGINECO's plant. Where, previously, buildability was a verifyable property of an engine in relationship to e.g., the inventory, now buildability of 'orange' and 'red' engines is an informed prediction based on members' knowledge about various kinds of socio-material circumstances.

These worldly contingencies are interesting for us since they invite consideration of the 'seen but unnoticed' aspects of work – that is, those aspects which pass the members by in, and as a part of, their everyday work but which, when there are problems or questions, are subject to inquiry (e.g., have you tried this or that? Did you do this or that? What were you doing when it happened). The answer to such questions, especially to the latter, illustrates the seen-but-unnoticed character of work in that, when called upon to so do, we can provide such accounts, although we do not do so in the course of ordinary work.

## Normal, Ordinary Troubles of Production

The above examples point to some of the worldly contingencies that Control Room workers routinely deal with as a part of their planning and scheduling work. More precisely we might say that all plans are contingent on what, following Suchman [Suc87], we call "situated actions". In our research we have found a series of expectable, 'normal' or 'ordinary' troubles whose solution is readily available to members in, and as a part of, heir working practices. That is, such problems do not normally occasion recourse to anything other than the usual solutions. Usual solutions invoke what we call *horizons of tractability*. By this we mean that a problem of the usual kind contains within it the candidate (used-before-and-seen-to-work) solution to that problem. These problems and their solutions are normal and natural and putatively soluble in, and as a part of, everyday work.

> **From the shiftbook:**
> SMR [suspended monorail] trouble 14:15 to 16:30, engines not registered into SMR, took 25 engines off the line using emergency organization.
> Info for Peter: part no. 04767534, box was empty upon delivery, so I booked 64 parts out of the inventory.

The emergency organisation involved picking up the engines by forklift truck, and moving them to a location where they can be picked up by the autonomous carrier system. A number of locations have been made available for this purpose where forklift truck drivers can access the Assembly Control Host to update the location information for the engine they just reintroduced into the

system. This is one of many examples where non-automated activity leads to a temporary discrepancy between the representation and the represented which has to be compensated for. The second example illustrates the same point. Updating the inventory in response to various kinds of events is a regular acitivity in the Control Room and the fact that Control Room workers have acquired authority to effect such transactions is witness to the normality of this kind of problem compensation activity.

## Dealing with Unexpected Troubles

Other problems that are not susceptible to these remedies are also interesting to us in that they demand a solution – one cannot remain indifferent to their presence – but that solution is not a normal or usual one (by definition) and, as we have said, members cannot remain indifferent to the problem. In order to keep production running, members 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 all material in the tower 'faulty' which resulted in new material being ordered from the logistics provider. This material was then 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 work-arounds which 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 members share them 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 social learning, however, is critically dependent on members' orientation to the larger context, their making the problem solution accountable to fellow members and their ability to judge the consequences. The following fieldwork material illustrates how problem solutions can get factored into ongoing systems development as well as how they can adversely affect the success of the system:

> **From an interview with one of the system developers responsible for the ongoing development of the Assembly Control Host:**
> [Such a complex system] will alway 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 bloddy system" then all is lost. Then our location information is wrong cause the driver doesn't always give the correct information; 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 bug fix" 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 bug fix 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, with problems that do not yield to the usual solutions, one could solve the problems in an automated manner. We would argue that human intervention (and resourcefulness) is needed to find and implement a solution to he problem. The plans that members come up with within this horizon of tractability do not usually work one way only – it is our experience that an unexpected problem can become a normal problem susceptible to the usual solutions in, and through, the skillful and planful conduct of members. That is to say, the boundaries between the types of problem are semi-permeable (at least). The order of the potentially problematic universe is not similarly problematic for all members, different members will view different problems in a variety of ways and, through the phenomenon of organizational memory [HOR96], this may lead to the resolution for the problem in, and through, the ability to improvise or to recognize some kind of similarities inherent in this and a previous problem.

It is important to note that problem detection and solving is 'lived work' [Liv86] and that it is also situated. That is, it is not to be divorced from the plans and procedures through which it is undertaken and the machinery and interactions that both support and realise it. Working practices and the structure of the workplace afford various kinds of activities that allow members to check the proper progress of production and to detect and respond to troubles. These very 'mundane' (i.e., everday) activities complement the planned-for, made-explicit and formalised measures such as testing. As in other collaborative work (see e.g., [HP00]), 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 claims 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 within the plant 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 plant 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)**
Now that the whereabouts of the oil pipes has been established, the question remains why Chris has them. Mark explains that this was related to conversion work Chris is involved in at the moment. This leads Jim to ask

if there are enough parts in stock to deal with the conversion work as well as other production orders. Mark explains how the inventory matches the need.

Having solved the problem of locating the parts, there is the question of how the problem emerged and what further problems may lie ahead. It is not immediately obvious that Chris should have the parts but Mark knows that Chris is involved in some conversion work resulting from a previous problem. Again, awareness of what is happening within the plant is crucial as information about the conversion work is unlikely to be captured in information systems as the work Chris is carrying out is not part of the normal operation of the plant. Rather, it is improvised work done to deal with a previous problem.

Jim raises the question if enough oil pipes are available to deal with the conversion work as well as normal production. Again, it is Mark who can fill in the required information and demonstrate to Jim how the parts in the inventory match the needs. As Jim comments in a similar situation: “What one of us doesn’t know, the other does.” Problem detection and solving is very much a collaborative activity depending on the situated and highly condensed exchange of information between members. By saying that Chris has taken the parts from the line, Mark also points to a set of possible reasons as members are well aware who Chris is, where he works, and what his usual activities are.

**(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.

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. [HP00]).

**From a video recording of Control Room work:**
Jack has ‘found’ an engine that, according to the IT system, has been delivered to the customer quite a while ago. It is, however, phyiscally present in the engine buffer and Jack calls a colleague in quality control to find out the reason for this. “It’s a 4-cylinder F200, ‘conversion [customer]’ it says here, a very old engine. The engine is missing parts, screws are loose, ... if it’s not ready yet – I wanted to know what’s with this engine – it’s been sitting in the buffer for quite a while.”

Here, the physical appearance is an indication of the engine’s unusual history. Together with the fact that the engine has “been sitting in the buffer for quite a while” this makes the case interesting for Jack.

## Discussion

Working in an interdisciplinary field (Computer Supported Cooperative Work) where computer system design has placed the social as central to its concerns, and predicated the design problem on the ordinary, situated and mundane activities of organisational members (see [HRR00] for a review), we have been interested in the way in which planning and other related concepts can be treated as culturally accomplished phenomena. In this way, we suggest that by identifying such concepts as contextually arrived at in and through the practical work activities of members, we can provide some more rigorous underpinnings for the investigation of the organisation of production. The implementation of production plans features the deployment of local knowledge and local logics, terms which we prefer to tacit knowledge, and where the emphasis is on the characteristics of individuals involved in the process. Such examples are interesting in many ways, not least because they are frequently enlisted to circumvent or speed up otherwise cumbersome procedures by, as it were, invoking the spirit rather than the letter of the procedure through gambits of compliance [Bit65].

It is a commonplace but nevertheless potent observation (e.g., [Suc87]) that plans are rarely simply and slavishly adhered to but generally involve, and typically require, the use of judgement. Specifically, the circumstances under which the plan is to be strictly followed and the circumstances under which modifications or short-cuts may be employed through the utilisation of informal teamwork or local knowledge is a matter for occasioned determination in the course of the work. In the case study, we have seen how production plans, and formal production logics such as the apparently all important concept of buildability, are treated as resources for the situated accomplishment of production, being oriented to, and used with skill and judgement, in order to get the work done. This is done in the knowledge that members may be required to account for a decision, or make a case in ways that can be seen and understood as manifestly complying with production objectives and rules. In this sense, production plans are less a device for directing production than a template for accounting for it.

## Conclusions and Further Work

We have seen how Control Room workers take advantage of the separation of planning and Assembly Control systems to make interventions in the unfolding production plan. This separation facilitates, to paraphrase Bowers et al. [BBS95], *production from within*. Production from within emphasises methods used in the Control Room and on the shop floor that constitute the local and internal accomplishment of the work. It is a practical achievement, constituted with just those present and just these resources to solve this problem for all practical purposes, here and now. Other ways may be used on future occasions, but here and now the problem is solved in this way with these people and these resources. *Production from without*, in contrast, seeks to order production through methods other than those that the work itself provides. In our case study, had the ERP system and Assembly Control Host been more tightly coupled, then the options at hand for following local logics in production might be compromised, either becoming impossible to action or increasing the overheads of workarounds [BBS95].

If, as is generally implied, the aim of production planning technology is to embed knowledge properties in systems, then production knowledge needs to be captured and managed in a way that will make it accurate, available, accessible and effective. Such a task is hardly trivial, and our concerns are precisely with the conceptual and empirical issues that need to be understood before such projects are to become feasible.

In pointing out, as we have done above, that the divergence of plans and actual production we are not being critical of the principle of planning. Rather, we are suggesting that its orthodoxies should perhaps be accompanied by complementary analysis of a more qualitative kind. What this points to, and it is connected to the idea of local knowledge, is the investigation of the subtle but essential competencies involved in making sense of (and thereby being able to make it available to others) the practical, here-and-now implications of a production plan. These could be described as competencies required for mutual intelligibility on the part of the members of a workplace.

Underlying much of the current work on production planning and management systems is the notion that to achieve the prescription of a task everything must somehow be rendered uniform and predictable. This pursuit of uniformity manifests itself in numerous ways. Yet the above exposition of production management work makes it clear that any attempt to see this as simply following the script is wholly unwarranted. Furthermore, a prime conception at play in rationalist view of planning is that there is a sequence of tasks that together make up a definitive version of best practice. However, the actual achievement of any production plan makes it clear that all that this is, at best, a contingent version of best practice.

Supporting production work in all its contingent aspects, we believe, requires that planning systems pay attention to the occasioned character of the logic of production. This is not constituted as mastery of the organisations processes and procedures, but in whether, when and how to deploy these more standardised forms in the routine accomplishment of the work in hand.

Since, as we observed, the boundaries between the normal and the unexpected, the order and the disorder are permeable, information systems development should not be conceptualised as a one-off process. Whilst it is true that current IT systems development methodologies take this into consideration and conceptualise development as an evolutionary process in which learning takes place, what is still missing is the connection of development with actual working practice. As the systems developer observes in the interview (see section **Dealing with Unexpected Troubles**), successful long-term IT development critically depends on the day-to-day interaction between use and development, between users and developers as they collaboratively track down troubles with the system and work to come up with solutions, as temporary fixes, changed working practices (e.g., stable work-arounds) or changes to the IT system.

This involves a number of propositions, which we intend to explore further: First, developments in computer-based systems may, paradoxically, create new sources of undependability. For example, as illustrated several times here, the discrepancy between embedded system and user practices. New strategies may be needed for the development of robust socio-technical systems, involving more sophisticated approaches to how human and machine elements are coupled. For example, it is important to recognise the limits to automation – that it may be unhelpful to try to cater automatically for some kind of variability, and that design may best be geared to allowing manual over-ride.

Second, the introduction of computer-based system provides particular opportunities for analysis and for practice – for example, highlighting the gulf between designed system and emerging 'normal practice'. This work will explore the opportunities for social learning in relation to organisational practices and system design. There are important issues here about how best to structure socio-technical configurations to facilitate potentially contradictory goals such as system integrity and local learning. The specific configuration in this case (the separation between the ERP and local Assembly Control Host, and the consequent local availability of system design expertise) offered important opportunities.

Finally, we conceptualise IT systems design and development as an activitiy situated within the same context as use. As mentioned earlier, we are involved in a project aiming to explore such practices by closely working with members in the Control Room of the plant to develop locally meaningful IT systems [VPW00]. The longer-term aim is to link these local systems with the Assembly Control Host and thereby with the larger IT systems infrastructure in order to facilitate the kinds of situated activities that members are involved in as they work to resolve the tension between plans and production as actual practice.

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