CENTRED FLOWS: A LEAN APPROACH TO DECISION MAKING AND ORGANISATION

John Rooke[1], Lauri Koskela[2], Sven Bertelsen[3] and Guilherme Henrich[4]

ABSTRACT

Koskela has argued that the flow conception of production is a key to understanding and generating improvement innovations. However, it has tended to be assumed that this view is appropriate for the analysis of processes, rather than of operations. However, it is notable that Shingo also conceives of operations in terms of flows. The flow conception treats the process holistically, as a continuum, time is central to understanding them. Events, rather than objects, are key units. It is argued here that the key distinction between a process flow and an operational flow is that processes are essentially passive, acted upon by operations. Conversely, operations, whether human or mechanical, have the quality of intentionality. It is suggested that the idea of 'competence', borrowed from ethno methodology is a prime analytic device for understanding operational flows. Human activities have the quality that they can be understood as practical competencies or abilities that we can acquire for ourselves. It is suggested that we can extend production theory to examine the production of organisation, as distinct from its usual focus on the organisation of production. The organisations which design, construct and manage the built environment may be viewed as social processes which are produced in the exercise of the operational competences of their memberships.

KEY WORDS

Lean Theory, Flows, Operations, Organisation, Competence

INTRODUCTION

This paper is intended to extend Koskela's (1992, 2000) theoretical work on the conception of flow, in order to allow a greater focus on the organisational activity in production. Koskela has argued that the flow conception of production is a key to understanding and generating improvement innovations. However, it has tended to be assumed that this view is appropriate for the analysis of processes, rather than of operations. Shingo (1988) treats production as two dimensional. Along one axis are

[1] Research Fellow, School of Construction and Property Management – University of Salford, 4th Floor, Maxwell Building, The Crescent, Salford, Greater Manchester, M5 4WT, UK, Phone +44 161 2956344, FAX +44 161 2954587, j.rooke@salford.ac.uk

[2] Professor, School of Construction and Property Management – University of Salford, 4th Floor, Maxwell Building, The Crescent, Salford, Greater Manchester, M5 4WT, UK, Phone +44 161 2957960, FAX +44 161 2954587, l.j.koskela@salford.ac.uk

[3] MSc, Consulting Engineer, External Lecturer, Danish Technical University, Roennebaervej 10, app 108, 2840 Holte, DK Denmark, Phone +45 4542 4705, sven@bertelsen.org

[4] Civil Engineer, M.Sc., MBA, Ph.D. candidate, School of Construction and Property Management – University of Salford, 4th Floor, Maxwell Building, The Crescent, Salford, Greater Manchester, M5 4WT, UK, Phone +44 161 2954143, FAX +44 161 2954587, g.henrich@pgr.salford.ac.uk

flows of material, the processes. Along the other are operations, of which some are flows of activity centred upon the worker. His intention in adopting this treatment is to direct our attention to processes and the way in which they differ from operations. This has proved a very fruitful approach for lean construction.

However, it is notable that Shingo also conceives of operations in terms of flows. The concept of flow is defined in opposition to the concept of transformation, as an alternative way of looking at the production process. The flow conception, in contrast to the transformation concept, treats the process holistically, as a continuum, time is central to understanding them. Events, rather than objects, are key units. It is argued here that the key distinction between a process flow and an operational flow is that processes are essentially passive, acted upon by operations. Conversely, operations, whether human or mechanical, have the quality of intentionality. It is suggested that the idea of 'competence', borrowed from ethno-methodology, is a prime analytic device for understanding operational flows. Human activities have the quality that they can be understood as practical competencies or abilities that we can acquire for ourselves. This latter kind of understanding may be particularly relevant to the analysis of organisation. It is suggested that we can extend production theory to examine the production of organisation, as distinct from its usual focus on the organisation of production. The organisations which design, construct and manage the built environment may be viewed as social processes which are produced in the exercise of the operational competences of their memberships.

This overall argument is discussed in this paper as follows. Beginning with a consideration of the flow concept and a short investigation of its origins in the work of Shingo (1988), we proceed by exploring the less examined topic of operational flows. We argue that these involve the acquisition and exercise of socially acquired competences. We then apply this conception to the consideration of organisation.

THE NATURE OF THE FLOW CONCEPT

The concept of flow is defined by Koskela (1992) in opposition to the concept of transformation, as an alternative way of looking at the production process. Transformation processes can be decomposed into sub-processes, which themselves can be further decomposed. This means that tasks can be designed and specified for maximum efficiency (Taylor 1947). Such an analysis involves treating the process as, in some respects, like a physical object. This is achieved by treating time as a fourth dimension, equivalent in some respects to the ‘first’ three dimensions of height, width, and depth. The paucity of this conception of time can be easily seen if we consider the interchangeability of the first three dimensions and the uniqueness of the fourth.

The flow conception, by contrast, treats the process holistically, as a continuum. Flows have direction, rather than parts. Also, time is central to understanding them. If we attempt to analyse their constituents we find that events, rather than objects, are key units (Chi 1992, 2005). If objects have height, breadth and depth, events have beginnings, middles and ends. Crucially, unlike objects, events follow in sequence. Thus, for instance, the end of one event can be the beginning of another. For Shingo (1988) processes are made to happen by operations (human actions); actions are events. Both processes and operations are flows:

> "*Process* refers to the flow of products from one worker to another, that is, the stages through which raw materials gradually move to become finished products.
>
> *Operation* refers to the discrete stage at which a worker may work on different products, i.e., a human temporal and spatial flow that consistently centres around the worker." (Shingo 1988:5)

But human actions are ontologically different from the physical processes considered by Chi (though she has done much to contribute towards a comprehensive taxonomy of processes). Shingo represents them as a separate dimension to flow, but this does little to clarify the issue. Actions can usefully be considered as flows that have a special quality: that they can be understood 'from within'. Livingstone (1987) illustrates the meaning and utility of seeing human activity 'from within', with reference to the patterns of movement formed by crowds crossing the road at a busy intersection. Overhead video tape footage reveals that crowds typically make wedge shaped formations. There would seem to be three alternative strategies for answering the question how these formations are generated: [1] using the video tape material, to take an overview of the whole system, analysing the flows as they occur to determine possible chains of causality; [2] analyse the behaviour of single entities, in order to discover their local organising principles. This second course is clearly appropriate to complex systems. However, for human systems, a third possibility exists. [3] We may interview participants in crowds, or participate in crowds ourselves, in order to obtain an inside view of how the patterns are generated. In this way, the *decisions* of the crowd's members provide an additional rich source of knowledge. Decisions, in this sense, can be seen as a particular type of operation as defined by Shingo (see below).

SHINGO'S CONCEPTION OF FLOW

Shingo represents processes and operations as orthogonal axes. This is, as he explains, to emphasise a point that he found to be widely misunderstood about his teaching. People in the West could not see that processes and operations are radically different phenomena. Rather, they continued to believe that processes are made up of operations in such a way that operations are just smaller processes that are added together to give the process as a whole.

By operation, Shingo means the intentional activity of a person or a machine[5]. Operations facilitate processes, without operations there would be no processes. But they are not the same thing. They might be seen as different aspects of production: the passive (process) and the active (operation).

Thus, we can look at the factory or the construction project as made up entirely of processes and, in a sense, we will miss nothing except operations). In other words, we can see the whole of production in terms of processes. That is to say, we observe what happens to materials (and pieces of information) as they flow through the project.

Conversely, we can also look at it as composed entirely of operations and, in a similar way, we will miss nothing (except processes). In other words, this is a

[5] A further distinction can be drawn of course between the intentionality of a human worker, whose intentions can be regarded as in some sense voluntary, and those of a machine which carries out the intentions of its designer.

different way of looking at the factory/project; we can see the whole of production in terms of operations. That is to say, we observe what people and machines do. The problem with looking at the project in this way is of course that opportunities for improvement that are apparent in a process view are obscured in this view.

Operations are very diverse and dynamic in terms of content and position in time and space. Thus, in order to aid the analysis of production systems, Shingo further classified the operations as (Santos 1999):

- Set-up operations: preparation of the workstation before and after the main operations (e.g., installing a scaffolding);
- Main operations: actions which actually accomplish the essential operation (e.g., pouring concrete into the formwork) and, also, those actions that help to achieve the essential operation (e.g., loading and unloading material);
- External operations: activities indirectly related to the main operation, or common to a number of different operations (e.g., lubricating);
- Personal allowance: activities that serve the needs of the worker in terms of fatigue and biological needs (e.g., rest, drinking water).

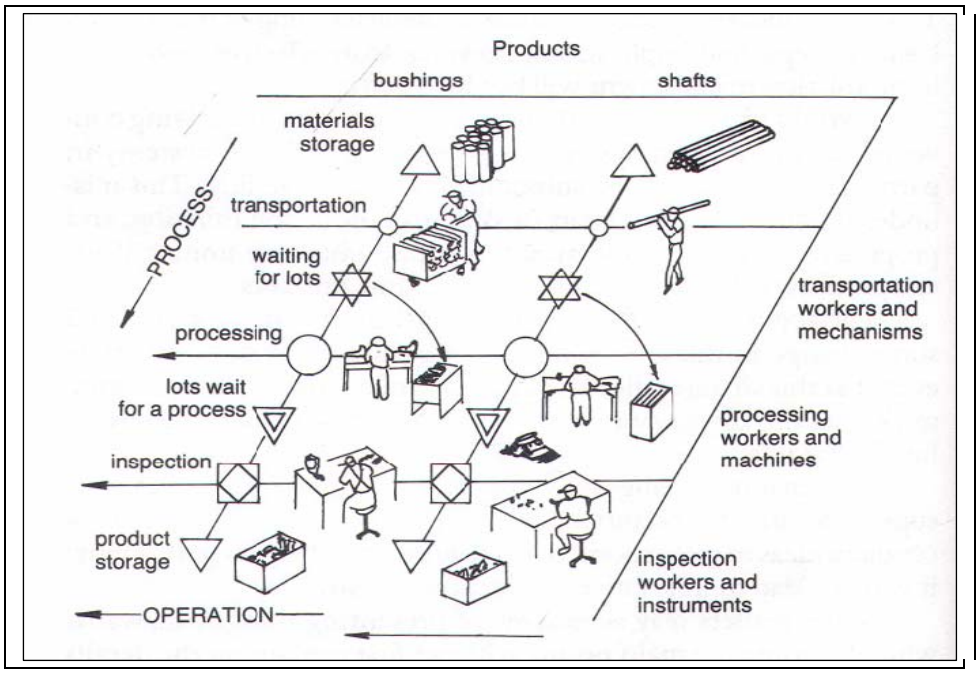

Fig 1. Operation and Process Flows from Shingo (1988)

Seeing the construction project in terms of process is what Lean Construction has successfully done. This is what gives us our three flows or seven flows (Ballard 1999; Koskela 2000; Bertelsen, Koskela, Henrich & Rooke 2006). The logical progress of this stream of thought is to develop a *construction physics* (Bertelsen, Henrich, Koskela, Rooke 2007). But what of operations? What kind of flows are these? Shingo tells us that they are flows which centre on the worker (unlike processes that pass through workstations, these are flows that don't go anywhere). In the next section we

examine the possibility of analysing operations in terms of competencies: a *construction methodology*.

CONSTRUCTION METHODOLOGY: OPERATIONS AS SOCIAL ACTIVITIES

The idea of the central importance of competence is borrowed from Garfinkel (1984) who recommends that we see all social settings (for our purposes, work settings) as self organising. More precisely: settings organise themselves through their members who, for the purposes of analysis are regarded as assemblages of competencies.

Livingstone's (1987) example of pedestrian behaviour at busy road junctions illustrates this point. Tapes made from an elevated vantage point reveal patterns emerging in crowds crossing the road at busy junctions. How do we explain this? We can do so by understanding what the phenomenon looks like from within the crowd (in which case we experience it as a member of the crowd, rather than an observer overlooking the setting). From this situation, we are in a position to understand the individual decisions that members of the crowd make. These decisions are based on their perceptions and our understanding of them comes from sharing those perceptions. It is these perceptions and the decisions based upon them that account for the observed pattern. We can understand, for instance, that the individual crowd member avoids someone coming the other way. We can also understand that to follow someone else negates the necessity for actively avoiding people. Thus we can begin to appreciate how this system works.

To understand a decision in this way is to understand it as a competence. This entails: (1) it is performative (therefore, unlike psychological definitions of 'decision' it is in no way hidden, but available for collective scrutiny and analysis); (2) it is understood from the 'inside' (we know how to do it, we can do it, we are not simply passive observers of it).

These kinds of phenomena have been addressed through complexity theory, but this approach tends to gloss over the major difference between human and inanimate systems, that the former consist of conscious, decision making beings who have ideas of their own. Sacks (1963, 1972) has suggested that the difficulties involved in producing scientific studies of human activity may have little to do with its complicated nature. It may rather be a consequence of the topic of enquiry being capable of producing its own account of its activities.

The distinction is easy to miss. It is not that human activity cannot be modelled or mechanically replicated, but that the activity of the model or machine is explained by its design, while the activity of the crowd is explained by the sense making practices of its members.

Thus, multi-agent modelling can mimic the auto-poietic properties of socially produced settings, but cannot replicate the conscious rule following of human agents. This is because the 'rules' in computer generated simulations are mechanistically implemented, effectively following a causal logic. The rules of human behaviour possess several contrary qualities.

1. They are “law like, spatiotemporally restricted and 'loose'.” (Garfinkel 1984) The term 'law-like' is intended to denote the generic applicability of the rules,

as is the case with scientific laws (though this is only the case within the appropriate spatiotemporal location). The term 'loose' is used to indicate that although such rules are intended as conditional, the relevant conditions can never be fully specified. This may in itself be considered as a quality of a complex (or chaotic?) system, but it is a feature that is problematic to reproduce in computer models.

2. They are reflexive to the setting which they govern. That is to say that they are produced within the setting for the purpose of governing that setting. It would seem that rules in computer generated models may have one or the other quality. They may be produced within the setting (and thus be spatiotemporally restricted) or they may be produced for the purpose of governing the setting (that is, they may be written into the programme). They cannot have both qualities simultaneously.

At any rate, the presence of consciousness gives us the possibility of understanding the system from within, as well as from outside, which is the correct way to scientifically understand a physical system. When we do this, many of the problems that arise because we attempted to understand the human system from the outside melt away. Competence is the key concept that helps us to do this. It gives us the secondary concept, membership. Membership of an organizational setting entails possession of the competence necessary to the maintenance (or moment to moment creation) of that setting.

It is easy to see that the competence required in order to constitute membership of an organisational setting is social. However, a little thought reveals that all competences are social in nature. That is to say that they are *inter alia*: socially taught, learned, or otherwise acquired; socially encouraged or discouraged; socially approved or disapproved in their exercise; socially observable, describable and accountable in their exercise (and thus their possession).

Garfinkel (1984:vii) goes so far as to observe that “In doing sociology, lay and professional, every reference to the 'real world,' even where the reference is to physical or biological events, is a reference to the organized activities of everyday life.” Competence then provides us with a very powerful analytic principle. Using membership and competence as the analytic units, we should be able to fully analyse any work setting. Take, as an example, the placing of concrete. In operational terms this entails the competencies of the following members among site personnel: steelfixer (to place the steel rebar according to the drawings); carpenter (to make and assemble the form-work according to the drawings); site agent/foreman (to order the concrete to site to arrive at the appropriate time); concreters (to pour, agitate and spread the concrete, apart from agitating probably regarded as unskilled work).

There is of course a process going on here, as the various elements of the concrete feature flow together, but this is analytically distinct from the flow of activity involved in, say, consulting a drawing, finding a correct piece of rebar, placing it according to the drawing, finding a second piece, placing that, etc.

The concept of competence also gives us the possibility of seeing these practical activities as instructed actions. This is a consequence of the 'insider' nature of the knowledge involved. This involves seeing the activities not simply as observed

behaviours, but in terms of what we need to know in order to perform them. It is 'knowledge how' rather than 'knowledge that' (Ryle 1963). It is significant that the Toyota Production System is heavily based on standards (= instructions). Thus, Shingo's practical philosophy for improving production and Garfinkel's academic sociological analysis end up at the same place! Such knowledge has proved highly problematic in the field of Knowledge and Information Management, leading to the contested distinction between codified and tacit knowledge, such that the latter is irreducible to programmable information.

Thus, we move beyond mere description to the possibility that our descriptions can simultaneously be instructive in the creation of a setting. For instance, Button & Sharrock (2002) have offered a description of the routine decision making processes of a production scheduler in a print works. They offer a specification of some of these, for instance (Button & Sharrock 2002:279):

> "The suitability, ease, difficulty, cost and speed with which different kinds of work can be done on different machines or whether they can be done on them at all.
>
> The difference one operator or another working a given machine can make, if any. [...]
>
> What allowances for preparations, down time, delays, stock availability must be made for a particular job.
>
> The cost to organize the print run and of the direction of economic advantage – to the firm or to the customer – that may result from any print decision."

ORGANISATIONS AS SOCIAL PROCESSES

The partial description quoted at the end of the last section addresses a particular kind of operation, that of organising production (as opposed to directly operating on materials).

Rummler & Brache (1995) attempt to integrate the three aspects of processes, operations and organization. Unfortunately, this attempt owes much to what Koskela & Kagioglou (2005) would term a thing metaphysics. Thus, their conceptions of both process and operation are devoid of an appreciation of these as flows of movement or activity. Indeed, not only is their conception of process one of a series of steps, rather than a continuous flow or stream, but gaps mysteriously open up between these steps (Rummler & Brache 1995:23).

However, while there is much to criticise in this attempt, it also contains a crucial recognition of three levels of performance. In addition to process and operation, there is also organisation, denoted here as 'control'. As with process and operation, Rummler & Brache rely on a thing ontology, following the conventional approach of seeing organization in terms of static organizational units: department, division, management line, management matrix, etc. Thing metaphysics seems to predominate in organisational thinking, even a model that is explicitly process based such as the European Federation for Quality Management's Excellence Model (EFQM 1999) is represented as a series of building blocks. Of course this is just an instance of a more general observation that process based solutions are often developed according to a substance metaphysics that renders them as reductionist and context insensitive.

However, work in ethno-methodology has clearly demonstrated the essentially time based nature of organization (Bittner 1965, Sharrock & Anderson 1986). Thus, it is reasonable to argue that organization is better seen in terms of flow and this seems to be where the work of Macomber & Howell (2003) is leading. Also relevant here is the work of David Cooperrider in developing Appreciative Enquiry techniques which fully recognise the psycho-social dynamics of change initiatives. These originate from a perspective which sees organisation as entirely achieved through communication (Elliott 1999).

It is reasonable to analyse the organizational aspects of the production system as a process consisting of flows of communication and as the operational activities necessary to facilitate those flows. Communication flows are often, of course, interactive processes such as conversation, meetings, or computer supported collaborations. Among organisational flows we can identify instructions (including drawings) and incentive flowdowns (Siriwardena, Koskela, Rooke, McDermott, Ruikar, Kagioglou, Sexton & Aouad 2006).

Competencies are extremely diverse, including *inter alia*: drawing or CAD skills, language action skills (Macomber & Howell 2003), the ability to demonstrate appreciation (Elliott 1999), etc. A future task will be to assemble a taxonomy of production relevant competencies.

The observations regarding operations and flows made in the previous section are also pertinent here, thus organizations can be seen either as assemblages of communicative competencies (operations), or alternatively as flows of communication (processes). In this conception, vital (but usually somewhat amorphous) features of organisation, such as commitment and trust, would be seen in terms of the operational competence necessary to generate and maintain them. Furthermore, these competences would be accounted for in terms of the instructional standards of behaviour which generate commitment and trust, rather than by any static, external description.

This may also be the missing angle from which we need to view engineering and architectural design. A design is, after all, an organisational device: it tells people what to do. It is in effect a plan. Although a design refers to an artefact and a plan to events, the way design is operationalised in its execution on site involves treating the specification as instruction as to how the construction process is to be carried out. Viewed in this way, a design should be seen as what Bittner (1965) terms a 'formal organisational scheme'. Such a scheme, though it may appear to the naïve observer to specify an actual organisational outcome, is in practice used by the organisation's members in ways in which the scheme itself does not specify. In this view, designs can be seen to be a resource to the construction process (Seymour, Shammas-Toma & Clark 1997).

However, the point is that designs are a special kind of resource inasmuch as they exercise control. As Schmidt & Wagner (2004) observe, plans can have two kinds of role: as 'scripts', to be followed; or as 'maps' delineating the 'territory' to be traversed. In the latter case, the element of choice inherent in executing the design is wider, though even in the case of scripts a latitude of interpretation is often present. The road map use is also relevant in design, where the Phase Schedule can be seen in such a light.

CONCLUSIONS

Drawing on the work of Shingo, a distinction has been proposed here between processes and operations which hinges on the intentionality inherent in the latter. According to this proposal, operations consist of intentional activities which are undertaken in the course of production, while processes consist of the movements caused by these activities. The latter are characterised as passive.

The utility of this distinction is yet to be fully explored. Nor is it clear at our present state of understanding, whether there are not viable alternative (and perhaps incommensurate) ways of distinguishing between processes and operations.

However, the current proposal does have the advantage of providing a theoretical basis for the study of planning and other organising activities and it is for this reason that it has been put forward.

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