ISSN 1012-277X S.Afr.j.ind.eng.

S A Tydskrif vir Bedryfsingenieurswese, Vol 3, No 1, Junie 1989 pp 1-9

SOFT SYSTEMS THINKING IN INDUSTRY

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ABSTRACT: The industrial milieu is a traditional area for hard systems analysis, and the optimization of processes using reductionist approaches.

Soft Systems Thinking, with its powerful use of conceptual modelling, has been neglected in the West, but has been applied by the Japanese - with some very surprising results.

It is suggested that South African industry could benefit from an injection of soft systems thinking.

OPSOMMING: Die bedryfsomgewing is 'n tradisionele gebied vir die toepassing van hardestelselontleding, en die optimalisering van prosesse deur die gebruik van benaderings wat die probleme maklik kan herlei.

Sagtestelselontleding, met die klem op konsepsuele modulering, word min in Westerse lande gebruik, maar het in Japan verbasende resultate opgelewer.

Dit word voorgestel dat ondernemings in Suid Afrika sal kan baat deur gebruik te maak van die sagtestelselbenadering.

INTRODUCTION

In a previous article [1], a soft systems methodology has been outlined. The main differences between this approach and the traditional hard systems methodology (for example Quade & Boucher [2]) are summarised below:

a) The former is a means of <u>understanding</u> a problematique. It is not primarily a problem solving technique.

b) After generating an understanding of the problematique, the soft systems approach goes on to identify a number of desireable, feasible changes. These changes are the trigger for a hard analysis. They become the focal point of an OR study.

c) The soft systems analysis does not stop at this point. It goes on to assess the likely effects of the introduction of the proposed changes. It examines the hypothetical situation which will be precipitated thereby - the <u>new</u> problematique.

d) It is very important to realise that the soft systems approach <u>makes no a-priori assumptions as to what the real problems are.</u> On the other hand, the hard approaches require an explicit statement of what the problem is, and what the objectives of the analysis are, before the methodology per se can be entered.

Although conceptual modelling is common to all systems methodologies, in the soft approach it assumes a much more powerful role because it is not constrained by real world considerations.
The feasibility of the model is not a major concern.
Far more important is the requirement that the analyst project himself into the systems thinking world, and to conceptualise as creatively as possible. To this end he must use tools which are peculiar to the soft systems approach. Many of these tools are described in Checkland [3], and Wilson [4]. Soft systems thinking has been used for many years in the study of human activity systems. The International Journal of Applied Systems Analysis is a good reference for studies of this kind.

Human activity systems are of course, prime candidates for the soft approach. But there are also a number of hard areas to which it can be applied with success.
One such area is that of manufacturing, in which a whole hierarchy of of system types is to be found, ranging from soft human activity systems, through designed abstract systems, to designed physical systems. Some important areas of the industrial milieu are addressed below.

SOFT SYSTEMS THINKING FOR INDUSTRY

Every industrialist knows that the worst money drains are:
Excess inventory; excess work in process (WIP); poor quality; and long lead times.
Traditionally, Operations Researchers have used reductionist approaches to problem solving in these areas. They have started out with a-priori definitions of what the problems are, and have used hard (and often very elegant) models to improve the problem situations thus defined, and taken as 'given'.
Very few of these analysts have stopped to consider the fact that the traditional approach may be the 'wrong' approach.
There is another way to approach problems in industry.
Instead of an analysis pressed in hard terms, soft systems thinking, and its powerful use of conceptual modelling, can (and should) be used to generate alternative views.
In order to illustrate this point, let us consider the four major money drains mentioned above.

Optimization of Inventory

The hard (OR) approach accepts the fact that inventory is necessary. Therefore, optimization means better inventory control through better procedures, and better modelling of the stochastic processes involved. This approach often works very well. Good examples of it are Kleutgen [5], and Edwards [6].

There is another approach to the problem. We could assert that since inventory is expensive, why not simply do without it?

How many analysts have tried to conceptualise a system in which there is no inventory? In which customer service levels are better than before, and in which product cost is reduced?
To model such a situation requires the analyst to retire completely from the real world, forget about everything that he has learnt about inventory control, dwell in the systems thinking world, and try to imagine a completely new approach to manufacturing.
He would then have to model this approach - an approach which would be alien to accepted manufacturing practice.
Such an exercise is difficult to do - even with the tools available from soft systems methodologies. Without these tools it would be almost impossible.
For this reason, perhaps, OR analysts have elected to continue using reductionist approaches, and to develop ever more sophisticated models for inventory management - never questioning the fact that the very thing they are attempting to manage could well be struck from the production system, and declared unnecessary.

Minimization of Work in Process (WIP)

Traditionally, WIP has always been regarded as necessary because if there are no queues on the shop floor, a machine could run out of work.
And to Western eyes, an idle worker is like a red rag to a bull.
Since it is impossible to balance the throughput of every subsystem in a production process exactly, bottlenecks will occur. They are accepted as a fact of manufacturing life.
And so, therefore, is WIP.
The OR approach to the WIP problem is to reduce its level as much as possible through the use of more sophisticated planning and scheduling techniques. This is indeed a very strong area of OR. The literature abounds with brilliant research on scheduling and capacity planning.
There is, however, no record (to my knowledge) of an OR attempt at devising (conceptually even) a 'zero' WIP production line. A line in which parts move from machine to machine and from operator to operator one-at-a-time. Where the only points that need to be busy all the time are the bottlenecks. But where the areas that feed them can increase productivity if they are idle from time to time.

Where an idle worker may be a good thing, not always a bad thing. Such a concept is of course unthinkable to someone who believes that WIP is the catalyst which keeps the production line moving, and which ensures that it will not grind to a halt.

Quality Improvement

In order to improve quality our managers concentrate on the Quality Assurance/Quality Control systems. They impose stricter tolerance limits, employ more elaborate statistical control techniques, and develop more and more quality assurance procedures so as to plug the gaps in the existing ones.
As a result, production costs increase. Hence we (in the West) have come to associate high quality with high cost - and vice versa.
Now what would our manager do if all the formal quality assurance and quality control procedures were suddenly removed?
Without controls, each worker would be responsible for the quality of the operation which he performs. Small groups of workers would need to come together from time to time to sort out major quality problems which would be bound to crop up. To the soft systems thinker a system along these lines is not difficult to conceive. In hard systems terms it would be unnacceptable, and impractical.
Could it be that in this conceptual system quality comes cheaply? And that high quality goods cost less?

Minimization of Lead Time

To the layman, lead time is simply the total time taken to manufacture a product. To the man in industry, it is a complex phenomenon which is composed of a number of deterministic and stochastic time elements. Some of the components of lead time, such as queue time and set-up time for example, can be reduced significantly through the application of OR models. Typically, the OR analyst takes the elements of lead time as 'given', and focuses on their minimization. But instead of developing more sophisticated models with which to analyse queues etc. has any analyst considered the simple removal of the elements of lead time from the shop floor? Conceptually, such a system would have no queues, 'zero' WIP, almost no move time from one operation to the next because machines would be closely adjacent to one another, and no delays due to poor quality because the system would be making a zero defect product.

LOOKING BACK IN TIME

Ten years ago, how many Western OR analysts, or industrial engineers, would have proposed any of the conceptual models discussed above as solutions to manufacturing problems?
Take inventory for example.
In Western organizations everything revolves around the inventory system. To say that inventory (and in particular, safety stocks) can be dispensed with would be regarded as heresy.

Ten years ago, these same models started to become the backbone of Japanese manufacturing. They are precisely what Just-in-Time, Zero Inventory, Zero WIP, Quality Circles, Total Quality Control, and Zero Defects are all about.
They are the reason for Japan's ability to produce high quality goods for less money, and with shorter lead times than ever before.

Perhaps if we in OR had done more soft systems thinking, and more conceptual modelling entirely within the systems thinking world, and removed from real world constraints, perhaps we too would have evolved the kinds of systems which have placed Japan on the map.

LOOKING AHEAD

Many functions which are still regarded as essential by the hard analyst are losing ground in the systems world, and may soon fall by the wayside.
In order to keep up with current trends we need to do a lot more systems modelling, and pay a lot less attention to developing elegant models for examining situations which are not questioned, but which are simply taken as 'given'.
Take forecasting for example.
The Master Production Schedule (MPS) is based on the forecasted demand that must be met. Forecasting, therefore, receives more attention than almost any other activity in the planning departments of industry, both in the West and in the East.
And so it should, because the entire organization is geared to meeting the MPS.

The classical OR approach is to take the forecasting activity as 'given', and to improve the accuracy of the forecast in one way or another. Under the circumstances this is a sound approach which has yielded some very interesting results.

But let us conceptualise!

Let us assume that, seeing the forecast is going to be incorrect (it cannot be otherwise), we simply remove the need for forecasting.

If this is done, the demand must be entered into the MPS from other sources. The MPS must also be kept up to date via these other sources.

The 'other sources' are of course the organization's major customers. It is their demands which we have ceased to forecast in this conceptual situation. The only way that their requirements can be catered for now is if they enter them directly into the MPS via terminal links to the organization's mainframe computer. In this model there is absolutely no need for guessing. The actual demand is known and entered directly into the MPS.

Preposterous?

Maybe not.

Leyland and Lucas, having done their soft systems homework, are experimenting with the idea. They have hit on a strategy which is ahead of anything that their competitors have - West or East.

There are many other areas simply waiting for a soft systems approach. To realise this, it is worthwhile contemplating Figure 1.

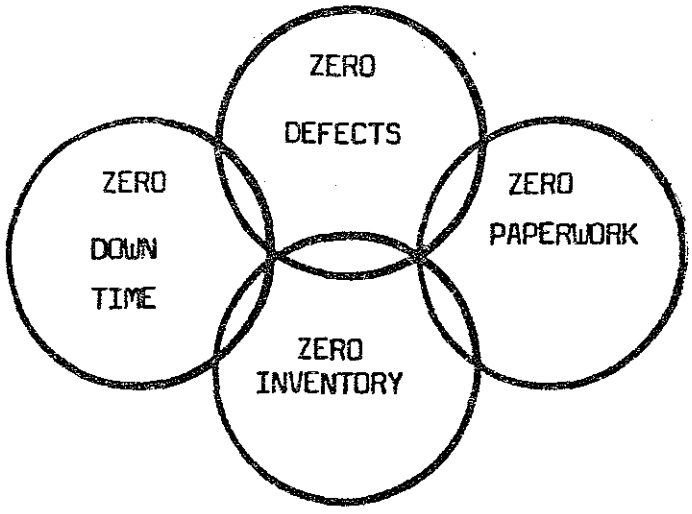

FIGURE 1: The Four Zeroes of Excellent Manufacturing.

CONCLUSION

The hard systems modelling of industrial processes has resulted in dramatic improvements in manufacturing. Operations Research and Mathematical Statistics have played a major role.
On the other hand, the need to optimize a particular process has seldom been questioned. It has been regarded as a 'given' need and hence as an a-priori condition from which the analysis must flow.
The soft systems approach makes no a-priori assumptions as to what should be optimized, or as to what the real problem is, or as to what should exist.
The soft approach seeks to determine the 'WHATS'.
The hard approach accepts the 'WHATS'.
The hard approach then determines the 'HOWS' associated with the given 'WHATS'.
The Japanese have deviated from the traditional Western hard approach. They have questioned the 'GIVENS'. And have spent a lot of time on conceptual modelling.
They have turned the world of manufacturing upside down.
As a result, at a time when the West has reached its asymptote in many areas of industry, the Japanese have managed to re-generate almost exponential-like growth towards levels of manufacturing as yet unattained.
What is the position in the Republic?
Of all the Western nations we are the only one with a negative productivity growth rate, our quality leaves much to be desired, and we fail to meet delivery dates. Our products are relatively expensive.
As a result we are trying to emulate the Japanese by copying them.
Hence the current interest in JIT, Quality Circles, etc. etc.

But could we not do better by getting on with some conceptual modelling of our own? We have unique industrial situations. We should, therefore, develop strategies which exploit the unique elements of South African situations to the full.
We need systems tailored to our 'WHATS'.

"We have the industries that should be able to compete with the Japanese. Can we do it?" (Juritz [7]).

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