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A TQC PHILOSOPHY

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ABSTRACT

There has been a recent upsurge in the quest for world class manufacturing. Tremendous amounts of effort are being exerted to attain Total Quality Control (TQC) - so as to be able to produce "the best". The EEC has stated categorically that it will only support accredited suppliers, and this has been partly responsible for the recent fixation on techniques for excellence.

These techniques often fail to produce results. This paper presents a systems based philosophy for working towards world class levels of manufacturing.

INTRODUCTION

This paper describes a philosophy for the implementation and monitoring of TQC. The philosophy is supported by a soft systems methodology which has been described in a previous paper (Sandrock [1]). In what follows some important aspects of quality management are discussed in the light of the philosophical approach. The extension of these ideas to YOUR specific organization and its peculiar problems is left up to you - since you are the person most qualified to make this transition.

THE ROAD TO TQC

The philosophy (and the methodology) is all about bottlenecking. What this means is that we need to isolate the bottlenecks in all the areas of the organization, and to concentrate on improving these areas. There are many kinds of bottlenecks. Some occur in the production line and limit capacity. Others are quality bottlenecks which limit quality, and still others may have to do with administration, communication, motivation, training, customer service, and so on.

NB: The point is that improving anything other than a bottleneck is simply a waste of time and money. Such action, by definition, cannot improve productivity. And this is what TQC is all about - productivity improvement.

There are three major steps in the approach, and each major step is composed of a number of small steps. The three steps are:

1) Structuring the problematique (the system of problems).
   There is no such thing as THE problem. A problematic situation, <u>from a systems point of view</u>, is never ultimately indivisible (i.e. composed of only one problem). In Ackoff's terms, problematic situations are MESSES, and we have to be careful not to be too reductionist in our approach to them because that may create an even worse MESS - Ackoff [4].

2) Determining the boundary of the RELEVANT systems.
Adopting a systemic (holistic) approach is all very well but there must be a cut-off point - a point at which we decide that we have gone wide enough in our search for all that is relevant.
Ramo [2] points out that "Surrounding a problem too broadly, trying hard to be absolutely complete, is very poor systems engineering".

3) A switch in emphasis from WHAT to HOW. In other words, a move from methodology to method - to the choice and application of O.R. techniques (and other tools), and thereby the solution of the structured problems. This step, and those that follow, are so much part of standard O.R. practice that it would be a waste of the reader's time to dwell upon them here. Hence only steps 1 and 2 are discussed in any detail.

4) Continuous improvement. "Perfect situations must go wrong" - a line from the song 'I Know Him So Well' - depicts the real world of industry too. Every time a problem is solved a new problematique presents itself for a Step 1 investigation. Total Quality is not an attainable goal, it is a moving goalpost on a never ending journey.

Step 1 in the approach is to realise that we have a problematique which is composed of bottleneck situations. Before anything else, it is necessary to identify these bottlenecks and to change the naive picture of the problematique into a rich picture (Checkland [3]; Sandrock [1]). This is not easy to do. It necessarily involves the cooperation of everyone in the organization, and it is to some extent self defeating because many of the bottlenecks will by their very nature automatically inhibit the rich picture formulation process. But assuming that the formulation has been largely (if not completely) successful, then the organization will be seen as a skeleton composed of bottleneck areas.
This is the skeleton to be attacked.

Ramo [2] sums up the essence of the systems approach very neatly: "The systems approach is a bottleneck breaker - the more it is used the easier it is to get it used. It promotes organizational innovation and may lead towards the creation of some new organization no one could otherwise have designed."

Step 2 involves us in even more work. A bottleneck situation, as we see it, is in reality a symptom of a problem. Hence if the bottlenecks are to be completely removed (as opposed to being temporarily improved) then the real problems have to be uncovered. In other words, when faced with a bottleneck the question to answer is WHY? and not HOW?

Every time we ask a WHY we move upward in the systems hierarchy to a wider system (to a meta-bottleneck?), and when asking HOW, the reverse is true - we move downwards towards a smaller subsystem. Too many WHY's, therefore, are not a good thing as the immediate problem becomes too widely surrounded. The trick is to know when to stop asking WHY and to get on with some HOWS. To this end, Churchman's criterion (Churchman [5]) is a very useful one to adopt.

His way to establish where the boundary should be is to ask the following two questions:

1. Does the next-wider system (the one which lies just beyond the system I am currently looking at) directly influence my system's behaviour?

2. Does my system directly influence the next-wider system's behaviour?

If the answer to the second of these questions is NO, then we should NOT include the next-wider system in the boundary. In other words, the system we are looking at is the only system we need to consider. With this choice of boundary we are not

truncating the RELEVANT problem area, and we are also not drawing the boundary too widely.

If, on the other hand, the answer to the second question is YES, then the next-wider system MUST be included within the boundary of relevant systems that we need to engineer.

As an example (a very obvious one) of where to draw a system boundary, consider the case of a farmer. His immediate system is his farm, his labour and other resources. Here he also finds his bottlenecks. Following the methodology, his quest for WHY's will undoubtedly lead him to the point where he must decide whether or not the weather is part of his relevant system. Considering this issue in the light of the above two questions, the answers he will get are: YES to the first question, and NO to the second. The outputs of the weather system affect his farming operations, and they certainly do constitute a bottleneck for him, but he cannot, try as he might, transform the weather. Hence weather is not part of his relevant system - it is a wider system whose outputs he must take as GIVEN, since he cannot change them.
The YES response to the first question tells him that the weather is a CONSTRAINT which he must take EXPLICITLY into account. This is his 'META-BOTTLENECK'. The NO response to the second question tells him that he cannot improve the wider bottleneck, only some wider power can do that.

The application of Step 2 will determine the boundaries of the RELEVANT systems which should be engineered. The point is to see this and to take the meta-bottlenecks as GIVEN. To see them as CONSTRAINTS which need to be taken into account, but which cannot be changed (engineered) from our level, or at this point in time, or whatever....

Step 3. Having isolated relevant systems for improvement, and having structured the problem situation we are in a position to implement a hard (O.R.) systems methodology.

The hard methodology, so well known to O.R. analysts is outlined only in brief below:

1. Formulate the problem.
2. Construct a model using O.R. techniques and prototypes.
3. Derive a solution.
4. Test and evaluate the solution, including a sensitivity analysis.
5. If acceptable, implement. If not acceptable reiterate through the steps of the methodology as necessary.
6. Maintain.

Step 4. An important point to remember is that as we eliminate bottlenecks, so new bottlenecks will raise their heads. Hence bottlenecking is an ongoing process. It is important for the OR analyst to realise that the new bottlenecks come about as a result of two completely different processes.

The first is the obvious one in which we achieve results that are aimed at. We know what to expect, and we know where the new problems are likely to be. There is no element of surprise here!

The second is a devious one. It is the result of complex feedback about which we have no (or little) knowledge, and it creates bottlenecks where we have not expected to find them. This property of cybernetic feedback is discussed again later.

Step 4 is a reorientation exercise. It is a 'turntable' step at which we weigh up the situation we now find ourselves in, take a deep breath, and proceed to implement Step 1 all over again.

BOTTOM UP vs TOP DOWN [In a SYSTEMS sense]

Bottlenecking is a bottom up approach from a systems point of view - but not necessarily bottom up from an organizational point of view. It is an attack on relevant messes in the

organization, no matter where they may reside in the hierarchy. In other words it is focused.
It starts with a narrow field of view - Churchman's boundary - and automatically takes on wider and wider angles of view as the implementation of TQC develops, all the while keeping Ramo's criterion in mind. It is in this sense a bottom up approach.

As such, it may seem inappropriate for implementing a meta-concept such as TQC. After all, the tenets of TQC are high level ones, and they relate directly to top management, so should philosophies for its implementation not be more meta-conceptual? Should we not start out with wide views, and remain orientated that way? The answer is simply that these kinds of approaches have failed time and time again - and the reasons are NOT all obvious.

However one reason which IS obvious has to do with the fuzziness associated with high level concepts. Consider for example such high aims as: customer satisfaction, zero defects, teamwork, motivation of the workforce, happy workers, excellent communication, cultural change - etc. Some or all of these aims are to be found in a company's TQC statement (or in its mission statement which is the same thing).

But the question is how do we improve customer satisfaction? Or more to the point - WHAT is customer satisfaction anyway? What constitutes a zero defect product? This is not an easy question to answer since a defect is something defined by management in the first place. Tackling quality problems is easier if the objectives are well defined (as they once were). For instance once upon a time a product was bad if it was not to specification, and acceptable otherwise. Nowadays it has a quality loss function (Taguchi [6]) associated with it so that it may be within specification limits but may not be good enough from a competitive point of view.

Even fuzzier are the goals concerned with the workforce.

What do we mean by wanting to make people happy?
There are no clear cut answers to all these questions, and to the anomalies that surround them.

The approach suggested in this paper is free of many of the uncertainties and fuzziness which surrounds the naive top down (systems sense) TQC approach in which the focus is concentrated on fuzzy goals - i.e. the goals of the meta-systems which lie beyond 'Churchman' boundaries, the boundaries of RELEVANT systems. What the bottom up approach says is that we do not try and achieve meta-goals directly via a maximization process, but instead we work towards this ideal by MINIMIZING bad practices which we have clearly and unambiguously identified. For example we do not try and make the workforce happier - we MINIMIZE unhappiness by removing a bottleneck which causes discontent - a communication or a training bottleneck for example. We do not consciously improve quality, but we MINIMIZE bad quality by removing a quality bottlenck. AND SO ON.
Why this approach?

Firstly, because it is easier and simpler to minimize bad news than to maximize good news (what is good news?). But admittedly, when bad news has been minimized this does not imply that good news is maximized. However, minimization as an initial step points the way to a realisation of how it may be possible to maximize what is left after the minimization process has progressed to the point where most of the bad bottlenecks have been removed. Secondly, because it is a sound philosophy. This assertion is expanded upon in the next section.

How does the approach differ from the approaches of the experts in the field - Deming, Juran, Crosby, Ishikawa, Shigeo-Shingo et al? Well, it is very close to Shigeo-Shingo [7] who made the following exhortations:
* Control upstream as close as possible to the problem.
* Think smart/think small. Use the simplest control. Don't

overdo it.

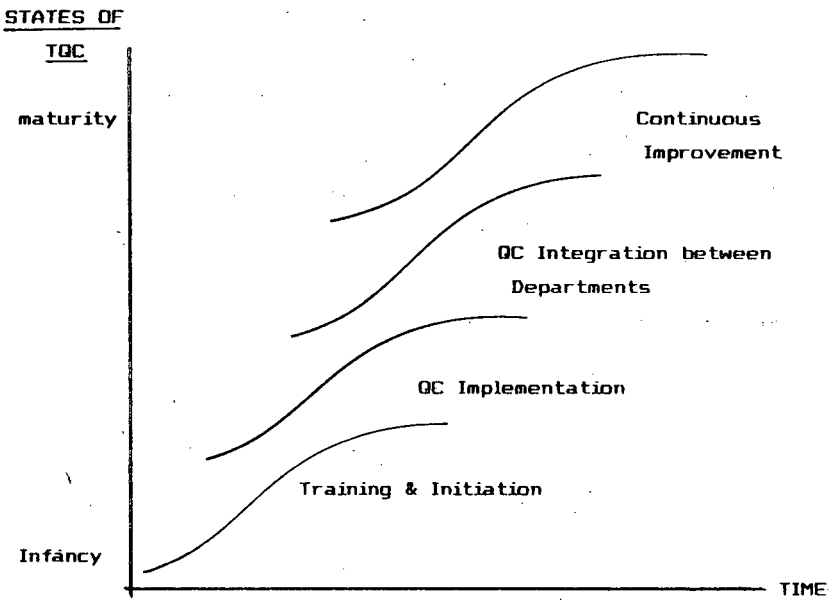
* Don't overanalyze. Act quickly - within hours if possible.

But at the same time it is not at variance with any of the other approaches. It is IMPLICIT in Deming's fourteen points [8], the 14 steps of Crosby, and the philosophies of Juran, Feigenbaum et al.

THE PROBLEM is that while these approaches IMPLY, inter-alia, what Shigeo-Shingo says so bluntly, many managers overlook these implications, and without access to the personal guidance of the quality guru they are attempting to follow, they tend to focus immediately on the meta-concepts. This results in a topsy turvy interpretation of the methodology.

And so, for example, Crosby becomes the buzz word in the organization. Training starts. Videos are shown. Everyone is enthusiastic and the sights are set pretty high - too high. When things don't happen quickly enough, then after a short lull, Deming becomes the new buzz word, and the videos and training manuals begin to pile up. Juran is next on the list, or is it Feigenbaum? - who cares anymore anyway? The TQC world becomes so filled with ambiguities it is almost impossible to achieve anything worthwhile.

The companies that adopt this route are constantly rewriting their TQC statements in an attempt to clarify the situation, and to get a handle on what they are really trying to do. It is a vicious circle. What they fail to realise is that the approaches of the gurus are all bottom up approaches, not top down approaches. The fact that the gurus stress the importance of top management committment to the quality initiative does NOT imply a top down systems approach. All the philosophies of the quality experts can be reduced to the simple systems diagram below:



TQC EVOLUTION

The systems above, all being Human Activity Systems, are negative feedback in character and therefore posses maximum levels of competence - saturation levels as it were. Now the important message is that only when a system has almost reached its saturation level is it capable of supporting the next-wider system, piggy back fashion as shown. This is because having passed the point of maximum (almost exponential-like) growth or development, it is experiencing strong negative feedback, indicating that it possesses sufficient resources and energy to support the next higher system in the hierarchy, without collapsing.

Preempting the natural evolution of TQC by jumping the gun results in collapse - in exactly the same way as trying to run before one can walk always results in a back to square one situation, coupled with despondency.

The bottlenecking approach is less formal than that represented in the above schematic, and has to do with the minimization of trouble rather than the successive maximization of human activity system content/output which we see in the diagram. Maximization is thus aimed at (and achieved?) via successive minimization. The approach quite naturally guarantees a no-run-before-you-can-walk situation. We never have to face this problem.

ASSUMPTIONS AND JUSTIFICATION OF THE BOTTLENECKING APPROACH

Assumption 1.

Industrial organizations are cybernetic mechanisms.
They are goal-seeking, servo-mechanisms. And like any other servo-mechanism they need clear cut problems (objectives) to work on.

Consider the analogy of a guided missile. Its objective is to hit a target. It has 'sense organs' which keep it informed as to how well it is achieving this objective. All the time it is using feed-back to correct for errors, to track the target, and to hit it. Our organizations too go forward, make errors, correct them, and by a series of 'zig-zags' they grope their way to their ultimate goals. And if this goal is Total Quality then the missile analogy is even more appropriate because TOTAL QUALITY is a MOVING TARGET - it is not a static status quo. Not only are organizations this kind of servo-mechanism, they are also very good scanning-mechanisms. They are good at scanning their data banks and coming up with answers consistent with a well defined problem situation. The key phrase here is 'well defined problem'.

Assumption 2.

Industrial organizations are creative. Their degree of creativity depends upon the nature of their political structures i.e. how democratic they are. The (unstifled) creative mechanism

has access to organization-wide information sources, as well as to the intuition, knowledge, expertise, and creativity of the workforce. This ability enables it to go the extra mile, and to surpass the competition, not merely keep abreast of it in the quest for world class manufacturing.

Assumption 3.

Human beings are information-processing systems operating largely in a serial fashion and possesing very modest computational powers in comparison with the complexity of the problems with which their environment confronts them - H A Simon [9].

Simon goes on to say that a theory of decision making should therefore be concerned with processes for selecting aspects of an environment for attention, processes for generating alternatives, and processes for choosing among alternatives. In the design of these processes the conservation of attention and the conservation of computing effort are of vital importance.

Assumption 4.

Industrial organizations are nearly-decomposable systems.

The concept of the nearly-decomposable system is due to Simon [9]. What it means is that the system is composed of subsystems with loose vertical and loose horizontal coupling between them. The loose vertical (hierarchical) coupling permits subsystems to be taken as GIVENS whose dynamic behaviour is irrelevant to the wider system - only their equilibrium properties being of importance. The loose horizontal coupling permits each subsystem to operate dynamically independently of the detail of the others. Only the input it requires and the output it produces are relevant for the holistic aspects of system behaviour.

Justification

If assumptions 1 to 4 are realistic, and valid, then the philosphy of bottlenecking is pretty well justified. On the other hand, the top down systems approach to TQC is somewhat at variance with these assumptions because of its global, fuzzy, and wider-system orientation. (These are the very properties which make it so appealing to top management). Very often, companies using this path adopt a methodology called "Targeting for World Class" (Whatley & Aaron [10]). The aim is to benchmark the competition (the world class companies) and then to try and copy their recipes for success. The result is that although this may lead to islands of excellence in the organization (such as JIT, MRP, Quality Circles, SPC etc), there is no mechanism to synthesize these improvements - and TQC is never attained. The ills of the approach are aptly described by Whatley & Aaron, and by many other opponents of the 'me too' syndrome.
However, these authors do not get to the bottom of the story - to the real evil. And the evil is that when a copycat studies the work of an industrial engineer or a quality manager elsewhere he asks the question: "What is he trying to do?" From a systems point of view this is the wrong question. This is his sin (and his downfall).

What he should be asking is: "What problem is he trying to solve?"

And so the copycat hurries off to copy the other man's approach thinking he understands what he is doing but in reality not seeing the point of it. Only an understanding of the PROBLEM SITUATION would enable him to do that. If he asked the right question, he would be precipitated into a systems methodology, such as the one described here, and would not be a copycat (it would be impossible). He would be using the technique of benchmarking correctly, and contributing valuable know how to the problem solving activity in his own organization.

ORGANIZATIONAL STRUCTURE TO SUPPORT THE PHILOSOPHY (and Methodology)

A number of years ago Stafford Beer [11] discussed the ills prevalent in industry at the time. His reason for exploring the situation was that O.R. had ceased to be a tool for devising important strategies, and was being used in industry at the merely tactical level. Beer lists the following common organizational faults:

1. Organizational Tenacity.
   This is simply a procedure whereby a viewpoint is fixed as a belief through constant airing of it. Managers (and governments) block new thinking until the new ideas have been discussed long enough to be generally adopted. The process is much like what happens on snow-bound roads. Every vehicle which passes makes it easier for others to follow until certain routes are obviously preferred. New thinking means broaching a new pathway, risking a snow covered road when alternative roads have already been cleared. The method of tenacity works well as long as social, economic, and industrial environments are changing slowly. But when these environments change rapidly tenacity does not allow us to cope.

2. Authority.
   In today's society this is possibly the most important method of fixing belief. We appeal to authority, i.e. to the will of the institution. An individual is part of the social system which gives life to the institution of which he is a member. He is thus a victim of the phenomenon described as the Second Law of Thermodynamics.
   [This is the levelling process, the price of conformance, which we see all around us. The melting pot syndrome. Everything is grey, or supposed to be grey. It is of course conceptual. The Second Law may only apply in principle, or in

part. It may go out the window when people realise what is going on and kick back. --- My comments - KS].

The high energy (information) levels associated with a particular individual, or group, tends to be absorbed by the rest because the system is struggling by its very nature to even things out. Often the high energy zone is seen as an awkward component and the rest of the system builds an energy-proof shield around this component.
[In order to contain it and not allow it to contaminate the orthodox corporate culture --KS]
The shield enables the boffins to pass information through it to managers, but does not allow the boffins to have any impact on other peoples' behaviour. This is the common 'backroom boy' situation. The whole problem is that creativity thus remains at tactical level and is stifled.
[And the O.R. boffins never become influential managers - which is of course the whole intention --KS].
Organization-man conforms to the will of the institution, thinking by the method of authority. The thermodynamic model sorts out the laws of the systems that operate him. Non-Organization-man because he does not conform is simply not acknowledged by the system - he ceases to exist and is censored.
[i.e. placed behind Beer's so called shield --KS].

The ills highlighted by Stafford Beer point to dictatorships of some kind. Dictatorships can be very subtle, can appear to be what they are not. For the TQC philosophy we need to circumvent these situations, and hence we seek a democracy of some kind. To see this it is necessary to realize that the key point is that implementation will produce results which were aimed at as well as RESULTS WHICH WERE NOT AIMED AT. The organization must be able to handle both kinds of outcome, especially the latter kind - the things which happen unexpectedly and which nobody planned or wants. The organization must also have the ability to adopt a constructively critical attitude to its means in the

light of ever changing goals.

And so it seems as if the right organization is one in which everybody is free to investigate problem situations, to propose solutions, and to criticize the proposed solutions of others (and most importantly those of the bosses). The organization must be able to change its policies and approaches in the light of all this criticism. But above all there must be a means of changing people too. Those in command must be removable, and replaced by others with different (better) ideas as the need arises -and without ill feelings. This is all part of the democratic approach to achieving world class manufacturing excellence.

This sounds very nice, and will definitely support the philosophy that has been proposed - but is it workable?

The answer is no.

We need to have some built in brakes on all this democracy because democracy is self destructive. And so an element of control must be brought into the picture.

The reasons for this have been pointed out by Popper (McGee [12]). Only the two major ones are given below.

The first reason is known as the paradox of tolerance. This paradox states that if a society (or institution) extends unlimited tolerance it will be destroyed, and tolerance with it. Hence there must be a mechanism for the suppression of the enemies of tolerance. If members of the workforce start to denounce certain issues and to forbid their adherents (followers) to listen to rational argument and criticism, or if they answer such arguments with violence or strike action or whatever, then there must be ways of bringing them back into line, or getting rid of them. The tolerant organization can only survive if it uses force to restrain the misfits.

The second reason is the paradox of freedom which was formulated originally by Plato. It states that unqualified freedom is self-destructive, and bound to produce the opposite. Hence proponents of complete freedom are also the enemies of freedom! In the organization there must therefore be a remedy for preventing the strong from enslaving the weak and the meek, there must be some form of survival mechanism.

The answer to the original question regarding suitable organizational structure lies in a democratic approach tailored to suit the specific organization in question so that it is not self-destructive. The approach must also be adaptive and will need to change with time - with changing needs and with a changing environment.

CONCLUSION

As with all systems based philosophies and methodologies, a certain amount of free interpretation pervades the ideas outlined in this paper. This is because the approach is intended to be systemic as opposed to being systematic - and this systemic property can only be fully realised if the analyst is free to tailor the ideas to suit his specific organization.

Sufficient knowledge has been imparted to enable an interested person to develop a powerful individualistic approach to TQC that will work, and that will prove superior to many of the approaches currently being adopted by copycat industries. Even if a copycat approach is good, one must remember that it has a relatively short life cycle because it is a closed system (a turnkey-like system) without new innovative growth from within.

A prerequisite for implementation of the proposed approach is that the people in the organization must have a common body of knowledge about quality management. This, if not already present, will be the first bottleneck to be tackled, and is

probably best addressed via the now virtually standard procedure of obtaining videos and training manuals put out by one of the quality experts. The methodology presented here will fit in with any of these philosophies because it is implicit in them anyway.

But there is a meta-aspect.

This is that because we have a systems orientation (via the methodology), and because we make EXPLICIT so many peripheral aspects of the TQC journey, our approach is not going to have a limited life-cycle. The classic life-cycle curve builds up to some asymptotic (saturation) value and then starts to slump - to die away. Ours will not slump because we have a hands-on tool for regenerating the TQC process from within, and proceeding towards those moving goalposts on the never-ending TQC journey.

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