

The Falcondale Collection

Stafford Beer

Initiates an Audience into the World of
Systems and Managerial Cybernetics

Session 3

Complexity & the Measure of Variety

What do we measure?

What do we measure indeed.

Well that was the question I left with you.

Well how is it we find what we want to measure?

You are going to tell me.

But I think that's what's stopping us.

Best of luck Karen.

I am trying to paint a picture where we see that systems are much more complicated than we thought, we may have thought they were, they are non linear, they are immensely confused and complicated we don't know where the boundaries are. They are basically subjective - now this is a mess - Now I try to establish that the measures we use are the ones we happen to have. They are not necessarily relevant they probably aren't relevant because they are based on wrong ideas. They are based on causation, linear etc etc.

Now the question I left with you was, what could you measure, what do you want to measure, never mind saying, is it possible. What do you want to measure, given this mess? Have a go, say something, even if it's Goodbye !

That's a good idea - but its subjective isn't it?

Would it be helpful if it was in common to all the

Yes it would be wouldn't it. Yes. Spot on that! Now money is usually used because various people... I've managed so far not to blaggard the Economists, but it has not been easy. They are usually responsible for these over simplified accounts of what things do and for the fact that they say that money is the measure of all things, and you can reduce everything to monetary terms. Well, I don't think you can. However, what Chris said is absolutely true. Isn't it? That you need something that is capable of taking in this mess and measuring it. Now if it's not money, what is it?

Now you don't know yet but I'm going to tell you, but the fact is, I want you to ask yourselves.

What is it going to look like, what is it going to do? Chris gave the first answer.

It has to be available to the whole thing.

What else could we say about it?

What is going on here that matters?

That the system works.

Right, the system works, okay, that's a very teleological answer.

If you look at the mess we are in. What is the measure of messiness? That's what I'm trying to get out of you.

Yes, somebody said it.

What?

Yes, Thank God somebody said it.

It's the complexity.

We are trying to manage complexity.

We used to say 40 years ago in Management Science, we have to deal with the four M's, Men, Materials, Machinery and Money, so those are the things you measured, but what you were trying to manage was complexity not these four things at all, they are problems, constraints etc. We need to measure complexity. Now how do we do that? We owe the answer for this to Ross Ashby. He saw this with very great clarity and he used the word VARIETY to measure complexity. Now, you say, this has higher variety than that, then you can see it's going to be generally more complicated, but I've already told you that Ross was meticulous, well that is not enough. So he defined VARIETY as the number of possible states.

Now we are getting very hard-nosed and scientific aren't we?

The number of possible states of something or of the system is its VARIETY.

Now the subject tonight is in fact VARIETY.

I want you to get a really firm grasp on this because it is the essence of cybernetics, to me. Now number of possible states. There is a light up there. How many states does it have? I don't know.

So can't you count Kathryn?

How many states?

Two.

Two, yes she got that. Yes great, but are you sure?

Well... I'll consult. Kate already got ahead of you. What did you say, Kate?

Three, because it could be broken.

Oh!!

If it's broken, doesn't it just mean the light is off. It means it's off but it's the states of the system we are trying to measure. Now that is different. It could be broken because the bulb has been taken out. Yes, but work backwards through the system. There could be no power. Somebody could have just blown up the power station. Yes. Now then. You're getting it. This is why things are complex. They are not as easy as they look.

Sorry, Kathryn your the fall guy here. I mean it seems so obvious it's two and then it turns out that, hang on what do we actually mean here. If you want to know the numbered states, you're going to have to count them, in just the way we have been doing and before you know where you are, you've got an awful large number on your hands.

Let's go back to the simple thing, whether the light is on or off. We say that because there is a simple thing called a switch which turns it on or off, would you believe.

Some of you would have seen a stepping switch, which has about ten settings on it which goes click, click, click.. now how many states have we got?

It depends how many clicks you've got.

It does, indeed.

You're doing very well for me Kathryn.

Well I did say there were ten settings which means there are ten intensities of light, right, ? So how many have we got now? We have got ten settings plus one for off plus as many things as Kate can think up here to obfuscate the issue.. So now that's all right.

Getting used to idea of trying to measure the VARIETY ?It's kind of weird, not as easy as it looks.

Now a lot of switches, these days don't have ten positions they have a continual .. They certainly do, well you tell me what the VARIETY of... It's infinite. It's infinite, .. is it?

No.

You walked right into that Glen, thank you very much.

So this is just a variable switch, so you just move it and somebody said infinite.

It depends on your perception of the person.

Ah ha that's it. Kate's winning tonight, isn't she because, doesn't it.

So what do you mean by it depends on perception. Don't you answer this one, let someone else do some work.

She says it depends on perception. Right, what does that mean? Perception of the system of the definition.

Absolutely. Go on.

Well it's whether the state of being on is a measure of intensity or not.

We've already said it is.

Now we are asking if it's infinite.

It's a very interesting question, it really is. It's defined by two limits.

There is not an upper limit right It's somebody who has very bad eyesight and can't..

Never mind about someone with bad eyesight what about someone with good eyesight. How many states can you distinguish?

It will depend a lot.

Now what have we done here, something extraordinary has happened, when you think about it. We were talking about the light, and switch, and its power generation as if it were something objective, but we have already agreed that systems are subjective phenomena - they are things we think of so what have we added, crucially added when we talk about your perception of the system.

Perception.

Individual perception.

That's getting better you see.

Perception, is just an abstract noun, isn't it?

What perception?

It's your perception, Glen says.

Well, of course it is and so now we have this extraordinary thing which is revolutionary in this thinking, it really was.

That you suddenly realise that the observer is part of the system and you can't talk about this system without this observer.

Now you see two to three hundred years of science said that there is a reality out there. We come along and measure it. If we can't see it we invent the telescope if its too small we invent the microscope and always there is this objective of reality and I'm some sort of God with all the instruments to tell you what it's all about and suddenly we see that what we are really talking about is constantly interactive exchange between the observer and the system. Now actually you see this was discovered in physics at the turn of the century . Does anyone know what I mean?

Heisenburg?

Heisenburg. Right anybody else know Heisenburg? The principal of indeterminacy Heisenburg realised this and just look how long it took to get out of ... This became the physics of quantum theory, quantum mechanics. Round about the turn of the century

Look how long it took to get into the system.

The system!!

When I was at school in the thirties Einstein was regarded as a nutter, and I distinctly remember asking a physics master what the Hell relativity theory was about and he said .. It's obviously nonsense my boy .

This is the thirties ! Because Einstein says parallel lines meet and we know they don't. Period.

I went away and thought about this, because obviously in Euclidean geometry parallel lines don't meet and here is this guy saying that they do and nobody pointed out to me, I had to discover it for myself, years later, that whether you think they meet or not depends on the axiomatic system you set up and Euclidean set up a system of axioms in which they didn't meet and Einstein monkied around with that and in his axiomatic system they do. So what's the big deal.

The big deal is perception.

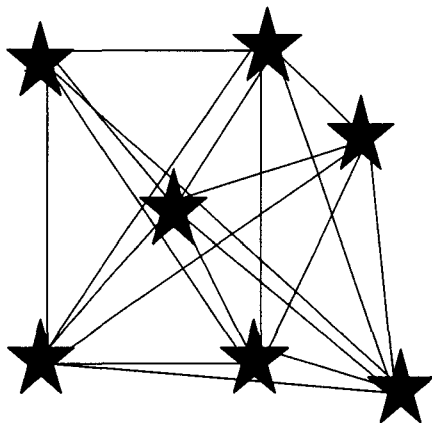
It's not a case of something called parallel lines meeting there isn't anything in nature called the parallel lines my friends, is there? It's a construct that we put on it and so what we think about it is conditioned by the way we look at it. Just like the red filter.

So we are in dead trouble here, is what I'm trying to say to you if we want to measure VARIETY we have, first of all, to specify what the system is that we propose to measure and outstandingly we have to include the observer in the loop. Now the Medieval people knew this. They had a thing called Euroborus.

Anybody heard of Euroborus? A Greek word. Well you have probably seen the picture of Euroborus without knowing its name. It's a snake that's eating its own tail. Or two dragons which are eating each other, and this is a marvellous image which shows us that we our whole language system and our whole perceptual system is .. it does consume itself and if you

have to say anything you have to be very careful how you express yourself or you get into something like a linguistic masturbation, to put it crudely because you're just using the language you use, to do the things you do with the language you use and then you pretend it's to do with something outside yourself.
Well this is hair-raising stuff.

Does anybody know the name of the branch of philosophy which is defined neatly as "What do we know and how do we know it?" - Epistemology
Epistemology from the Greek *Episthimi* meaning - knowledge and what I was saying to you in the last session was all about Epistemology only I didn't admit it. Now you see we are coming to grips with it. It is about what we know and how we know it. Now if somebody comes along and says I can tell you how the economy works and it's like this, and these are the words we have to use to describe it. Then how are you going to know whether this makes sense or not, given that it is a model, given that it is low VARIETY model please note, in a very complex situation, ho. ho. Do we really need a low VARIETY model in a highly complicated situation. I should say not. How are you going to know if it works. The only answer is of course ?? is if you apply the nostrums in the economies to the economy does it have any effect? Hey presto. Do I need to go on. It doesn't work. We adopt monetarism, total disaster, so we say there's something a bit wrong with our ?? I'm introducing this word, "model" more and more because if you abandon the idea that there is a reality which we are supposed, God is supposed to tell us about, or we are supposed to know about somehow and substitute this notion of the observer trying to understand what the Hell is happening in a very complicated situation then it's obvious that the Robinson Crusoe kind economics is not going to work and if you want the proof, it doesn't. So ?? you can be a Keynesian, you can be a Marchel, a Marxist, a Friedmanist you can do all of these things and none of them work. So one of the things I became kind of famous for was attacking the business schools. They are all teaching different things somewhat different, the only thing they have in common is, you see, is the scientific truth isn't it. They are all teaching one thing in common. What is it? It is that none of the teaching works. It's no wonder I'm not very popular!
Well now, we are really getting to grips with this thing, you know, I realise this is still very abstract and I thank you for hanging on for me, but I see you do.
Now we have to get back to the counting business if we going to try and quantify things, and we have already seen that is not easy. You have to specify the things with the lights .
Now, let's have a look at something here.
[Stafford draws seven crosses onto a drawing pad and holds it in the air for inspection]
Somebody tell me the VARIETY.
Seven.
Good answer. Somebody can count anyway.
Ah ha., see you are all getting suspicious, seven? .. seven factorial? one?
Who said one? That's very interesting.
Why?
It depends how you perceive it.



$$V = n(n - 1) \text{ two way connections}$$
$$= 2^{n(n-1)} = 2^{42} \text{ on or off states}$$

If you perceive that it is more than simple crosses then the VARIETY is one.

Yes, so you are in a universe of crosses, or something like that.

So we get that $v = 1$ our next bet was that $v = 7$ well there is an obvious reason for saying that.

Now somebody has already started to wonder if that was adequate.

Where do you go from there? If the crosses are states...

Well, let me take a little discussion here before we get back to that.

See if we are talking about the system, then we have a suspicion that this is a system. Then these things are interconnected and the question arises how many ways are there of interconnecting seven things.

Who knows?

It depends if you arrange them in a line or in a space.

No. All the possible interactions are ... I didn't arrange them in a line for that reason - so this is related to this and this to this.

6×7 is the answer.

It is $v = n$ times $n-1$ and in this case it's 42.

Now you are all sophisticated people, because if you weren't you would have said 21.

Why would that be?

The school books will tell you that it is $(n-1) + (n-2) + \dots + 1 = n(n-1)/2$

Why, because if you put that in then you've also got that Now, why is that wrong from a cybernetic point of view?

I can't hear you Karen.

They don't have to be the same .

That's right. Ask an uncle and a nephew . You've got it. They are not the same - So this is the sophisticated answer and the school book which says it's 21 is the very unsophisticated answer.

Now we come to Glen's point. We've got all these interconnections so the thing is beginning to look like this with 42 connections. He said maybe they are on or maybe there off. Now that

is the simplest case. If these are 'on' or 'off' who cares to say what the is of that number when any one of these may be 'on' or 'off' . You've got it 2 to the power of 42. Now that is rather a large number and that's only if it's 'on' or 'off' that is not taking into account Kate Bailey's version of the world in which it may be 'on' or 'off' for all sorts of such bloody reasons which is the truth of the matter after all. So this begins to get extremely complicated. Now if you want to know what the VARIETY is of any situation its obvious you have to make a very careful statement about what it is you are dealing with because the answer is going to be all over the place.

What we find in management and I'm forced to get round to management, because that is my subject, is that most people in management don't take the trouble to ask themselves what exactly they are computing with.

Why do you think that management and unions never agree about anything. It is because they are talking about quite different systems with quite different VARIETIES.

Here we have just this very week a rail strike and they're just not communicating and they think it could be to do with politics, I don't know what they think. I am the cybernetician, observing this lot and I am saying quite simply that they are just not talking about the same system. If they were, they wouldn't know how to measure it. I hear managers talking very simplistically about situations, which when I go and talk to Union people are perceived as infinitely complicated because of families and social life which is being reduced to almost nothing by management who is saying - Well time and a half or something very very simple. I have told you I have worked in this stuff all my life and I'm not a theoretician, well I suppose I am but it's based very much on my own life. I have had many dealings with trade unions and I have never once had the slightest difficulty with any of them. Now why should this be? I'm not a damned genius. I think about those things. I want to give you one very strong example of this - The height of my managerial career was as the Development Director of International Publishing which at that time was the worlds largest publishing company.

It was run by Cecil King who was the nephew of Lord Harmsworth it was the thing in publishing. Now, this was the thing that Bob Maxwell eventually got his hands on but this was a long time later, let me make this quite clear. I left in 1970. He didn't even get it for another ten years. I was in charge of Research and Development and the whole of computers and all of this jazz for the whole of this enormous company.

Think of the date, in the late 60's. I was the first person in the world to launch a publishing enterprise through electronic screens. It was called the Stockbroker Computer Answering Network - SCAN - and it put into stockbrokers offices on line real time information - changed everything - more or less destroyed the stock exchange by the way - but it took them years and years to catch up with that and then we had the, I don't know if you'd remember, it's not all that long ago, the whole thing blew out of the water because they didn't understand it at all.

I went to the two leaders of the trade unions. Now they were very interesting men Briggan Shaw was the key man here. It's too long ago for you to remember the name but you see I always start the negotiations with the belief that the other guy is a decent sensible man, not some sort of blithering idiot who wants to destroy society, which seems to be the way that

people treat this. I said to them, look, printing has been the same for five hundred years, we've just sooped it up a bit but Caxton would recognise the presses in the Daily Mirror, just like that. He'd say it goes a bit fast doesn't it but that's all. Now we are going to scan these pages electronically. We are going to have automatic page composition. Now, by the time I was talking we had already got column composition, in other words, you could get a column that was right hand justified, the hyphens and the margins being correct. Now we are talking about the whole damned page. This is rather linear, although it's in two dimensions its a linear job, the whole page is a very different matter because you have to put in the photographs and the works. Well my lot solved the problem of automatic page composition. Now, you will notice that this makes most of the printing unions redundant. So before I saw my colleagues on the Board about this I saw the Trade Unions and I said look what we have got here and I left the page with them and the cleverest man sent me a note saying Stafford: The writing is on the wall. Do you have to make it so bloody obvious?

Isn't that nice, you see so I took this guy out to lunch and said now what are we going to do? The problem of course is that the Unions are conceived like Medieval guilds, in many cases, and certainly in the printing unions. You apprenticed your son and he inherited the job. Suddenly somebody comes along with a bunch of electronics and says put away your hot metal, it's all over.

I said to them. Look it's obvious isn't it, this is going to happen whether you like it or I like it's here. How do we look after your members? All we have to do is train your members in electronics, that's all. Most of you kids are at school, you don't have to put them into hot metal which is a dead loss put them into electronics. I said my company will subsidise that for you we will give scholarships etc. to get into electronics and take over this technology and you'll be just where you are now. No problems at all about it, really. Why didn't it happen? I put it to the Board of I.P.C.. They were highly dubious because they'd lived like this all these years.

I.P.C. was very advanced in having me there, I can tell you, !! Associated Newspapers, Daily Express, and these people were not about to buy this, one little bit. The whole industry has to move together. So what happens, years and years later? - I left in disgust.

We had - Waping - where an embattled city is set up in the Isle of Dogs, barbed wire, police, to keep the unions out while they are junked in favour of electronics. Now this is an outrage. Totally unnecessary. I suppose you are thinking I'm talking politics, well I suppose I am but I'm trying to, I can't help it, I'm trying to give you examples, this isn't airy fairy stuff. We are trying to absorb the VARIETY of the situation through the latest technology which is a way of perceiving, isn't it? You perceive in the world either hot metal, to simplify it, or through electronics and if electronics is coming then this is what you've got to do and you've got to stop talking all this jazz which would make Caxton laugh. Now what you've got to do is understand the system you are dealing with. I've now added understand the technology by which you perceive it and keep your mind open that you may not have all the technology yet but that there may be more around the corner so you have to perceive of practically everything.

You do realise that Science fiction was never more than a couple of years ahead of science fact. Practically everything that is in science fiction has already happened, men on the moon, nuclear power.

20,000 Leagues under the Sea. When was that written by Jules Vern? In the 19 century , clearly a nuclear engine, he didn't quite know it but it had a furnace that never went out, we've got one!. No wonder they called the first nuclear powered submarine Nautilus. They recognised it. The human imagination is followed very fast by the ability to reify , I like that word, does anyone know it. It comes from the Latin it means to make it a thing concrete or real We reify our imagination and we are constricted only by the models we have and the VARIETY we can handle - This is our new universe folks! It really is.

You start looking at newspapers, start looking at it in this light and you will see that the arguments people are having are bizarely unreal. We are living in a dead world . it's all over, and we have to find the new way and we have to look. Somebody here speaks Spanish here don't they?. [STAFFORD THEN SPEAKS IN SPANISH] do you know this song?
TRANSLATION : Walker there is no road, you make the road as you walk.

Now I could give you that as a motto. It's wonderful, isn't it? If you follow the roads everybody has laid out, your going to the same disastrous mess everyone else has got to.

I was reminded earlier this evening. I was walking around in Israel. My only trip to the Holy Land, totally mind boggled by it. I was walking the hills in the Sea of Galilee thinking about Jesus when I came across a post which said Armageddon!! The story of my life!

Here we are with our problem. I've really tried to loosen up your thinking. We are hanging onto the notion of VARIETY. Now then what are we going to do with it? Are you going to go round counting things and try to actually imagine how large they are and try to count. This won't do you know it really won't. We have been taught, that measurement, mainly by accountants, We have been taught that measurement is an exact science and if a penny at the end of the day is left over, the banking staff must be kept in to find it. Statistically the penny means nothing. It's a paramental error. A million pounds is an experimental error in most of the stuff. That's not the way into VARIETY. Now let me gently suggest to you what is the way into VARIETY. If I got up, and held up a coat a rather unusual, let's say it is very small or very big. I say I have got this coat its going begging. How do we know who will fit this coat. Somebody might say, That is a large coat I'm 6'5" it may fit me, or somebody could say that is a small coat I'm only small. Let me try it on. We say that kind of thing, don't we? The VARIETIES are being handled without counting, that's my point. We have no problem in saying this is bigger than this without calculating as we have been taught, mainly, forgive me, by accountants. If I said I have this piece of furniture. Will it go into that alcove. Unless it's very marginable I'm going to say yes, or no it won't. That is the decision I want. Now we could go and measure the alcove and measure the piece of furniture and say well the alcove is 3'5" and the piece of furniture is 7'6" I don't think this is going to work. We don't need to do that, because we make comparative VARIETY evaluations and most of what we do in the real world is about that, I think.

Now if we start thinking about our problems in terms of matching VARIETIES , we are onto a new ball game altogether. So it's no use the Minister standing up in the House and saying We have no statistics for the number of Lesbians who are running a-mock in Newcastle....or whatever, not that I'm saying Lesbians in Newcastle... Oh help somebody I get myself in to some terrible trouble.... What we say is let us look at what we can assess. Now when I said measure I don't mean count, necessarily. Now than let me give you this scientist from Mars.

A very good scientist but knows nothing about Terrestrial matters. Out there he sees a green field, with goal posts at either end and unknown to him a set of 11 guys a practising. Now these 11 guys have red shirts on and they start off down the field and they are pushing a ball between each other and somebody slams it through the posts then they take it back and start all over again. So they score 370 goals in half an hour. The Martian scientist is observing this, and thinks, very interesting this. What is going on here? Somebody says to him. Well we have invented this game called soccer and that the objective of the game is to stop those people doing that. So what did the Martian Scientist say. He is facing a very high VARIETY situation. What he notices is that the ball goes back and forth and the ball then goes through the goal. The Martian scientist says let's put a large slab of concrete in the way and they will miss, they won't get through it. He does that, and then down come the 10 men in red shirts and they go round it. The Martian scientist says Bloody Hell. I wasn't expecting that. He tries the strategy, - Just think it through from his point of view. He tries putting a lot of little posts all over the place. Now these people, who are known for their dribbling, he doesn't know the word, but they come down and just play round them all and still score 380 goals. What's going on. Clearly these 11 individuals are governed by their own control system. They must have something in their head something which tells them how to operate. So the Martian comes along with an electroencephalograph puts it on the head of these people. I will try and find out what Paddy is thinking when he goes round the concrete post. - Just follow this through, - It's bloody fascinating. What are you going to do now. You've got all these brain waves printed out and now you say clearly they are communicating with each other somehow. How do they do that? I don't know, so you wire all these electroencephalographs up to a computer and you try and make a model of the whole damned thing. Now this is not going to work, because they will fall over the wires so you have a huge R and D project which is going to cost the earth as to how you transmit by the radio to the computer as to what is going on in the brains. Now you only have the problem of finding out the model whereby all these brains interact. Does this not have a ring of truth about it? How do we stop these 11 men from scoring all these goals? Isn't this how we proceed with things? Now what is the answer? No, not take the ball away.

Anarchist!! Yes, it's put another 11 men on the field with white shirts on to stop them. Now, you have discovered Ashby's Law, which I think is as important to management as the law of gravity is to physics. What is it that you have just discovered? Only VARIETY can absorb VARIETY. You don't have to count all these states you have to match them. Say I waived my fingers around so much you didn't know how many fingers I had, but supposing, judicially as a good professor I kept putting them together, finger tip on finger tip, as in prayer. You still wouldn't have time to count but you would be able to say he has the same number of fingers on each hand. That is the sort of thing I'm talking about when your no counting, your doing something much more sophisticated. You are matching VARIETY. Now all our problems arise, or attempting to disobey, Ashbys Law, now you can't it's the law of nature, you see. We go around with management systems that consistently ignore this. The Chancellor of the Exchequer says, I want to control the money supply and inflation then the economy is under control. What? all you are going to do is create all these people running round the goal posts

hiring hordes of accountants and lawyers No problem. Then the Chancellor of the Exchequer is left standing there like a lemon! It's their favourite occupation, as you know.

You've got a traffic policeman standing at an intersection the roads look like a Swastika so he can't see what is happening down each road because of the bends. He can't see. He's got a three mile queue down one of them, he doesn't know. So he is waving people on. He has no regard as to the total picture. Which is our big system, holistic noting because he doesn't know anything about it, not his fault. What I'm suggesting to you, that all our management techniques fail to recognise that the system is, can't measure it because they are using the orthodox measures don't understand the law of requisite VARIETY. Move in there with a load of glowing stuff and say this is what we'll do, then it doesn't work. So what do they do next, Mrs. Thatcher was the great exponent of this, - What did she do? They don't understand. We'll have to do it much harder. [Stafford punches his palm with a clenched fist.] Push it, sell it, increase it, - the fact that it doesn't work, that it's going to get worse and worse - that's just too bad we won't notice that.

This is my whole message about management.

I have finished the first day with where I wanted to get to.

In the next few days I'm going to try and make you a model of how to do this. Before I can offer this to you, you'll have to see why it is that our systems don't work, and you have to recognise that they don't. That's why the newspaper exercise. I want you to look at the newspaper and you will suddenly find, I guarantee, I don't know what's in the newspaper but I guarantee you will find examples lying all over the place, of people who are trying to disobey Ashby's Law because they haven't recognised it. It's simple. All great ideas are simple. The only opponents of cybernetics some of my dearest friends amongst them say the only trouble with Ashby's Law is that it's a tautology

it's obvious, that it doesn't tell us anything. Well I have tried to introduce it to you in a way whereby it does tell us something, of course it's tautologous if the whole of mathematics was tautologous if it weren't it would be wrong. Doesn't mean to say it's useless. Does it?

I want you to think on what I've said. I want you to sleep on it. Look at the papers, look for validations, look for counter examples, prove I'm wrong whatever. I also told you I was going to give you a formal exercise. I would like to end tonight by setting this exercise and here it is and I shall dish it out and you can spoil your nights sleep by trying to read that but I want to record it for the cameras and I am going to ask Kate Bailey if she'd be kind enough to read it because she has a mellifluous voice.

An Exercise in WHAT - the problem

You have been appointed manager of a shop engaged in jobbing production, and have been finding out the form - which is pretty awful. Some shifts go well; but on others two types of difficulty arise, either separately or together. One difficulty is that a shift may throw up a loss compared with standard; the other is that a dissident faction of work people may decide to cause trouble - and that consumes too much energy in handling the wild cat strike threat.

It turns out that there are two matters under your control that bear on this. Some work attracts a bonus rate, and the loading of this work can be manipulated. It seems to be generally accepted on the shop floor that more than 30% bonus work is 'good' while less is 'bad'. There is another and unpleasant kind of job which you can always run (or not); this, according to agreements, involves a flat 10% extra payment for the whole shift.

The production director has said that when you start on Monday you must operate this system as best you may. But until delicate negotiations at a higher level are completed he would like to see as little trouble as possible. So you set to work to discover what actually happens - and it follows a definite pattern.

If there is smooth working (i.e. no dissidents) on a shift, it will continue on the next shift unless the proportion of bonus work is bad. Then there is trouble, unless it is clear that the previous shift made a loss - in which case the trouble makers make no headway, because the earlier loss realistically explains the bad bonus. Indeed, if the bonus is good following a loss making shift, trouble will certainly break out while people argue what the management is up to.

If there is trouble on a shift, then that too goes on into the next shift, even when the bonus is good and the extra payment is made, if the first shift made a profit. But there is an interesting exception to this; if the extra payment work is not put in, this seems to be taken as a sign that the order book is falling and that men may be laid off. At any rate the trouble stops. When the trouble shift also makes a loss, then this weakens the dissidents' hand, and there is no trouble on the next shift - provided that the extra payment is put in.

Given a profitable shift, the dissidents will see to it that the next shift makes a loss, unless there was also trouble on the first shift. In that case trouble making is apparently too dangerous - because it doesn't happen, unless both the bonus is bad and there is no extra payment, when the dissidents will get away with trouble making again.

After a loss making shift on the other hand the next shift turns out to be profitable so long as there was no trouble in the first shift, these dissidents are very careful, because if there was the loss would certainly continue. However this whole situation is inevitably reversed if the extra payment is not made, again this appears to be taken as a dangerous sign in some circumstances (if not others).

Its all terribly complicated and your hands are tied so this is certainly not an exercise in industrial relations, so you must not interfere with those, but you do have a guarantee that the shop floor will respond true to form. What is this an exercise in? Then can you solve the problem? Is there anything you can do to ensure making a profit and have smooth running as well. I'll tell you this much, we can work out from the state of affairs from the last shift on Friday night that your first shift on Monday morning is bound (a) to be an uproar and (b) to make a loss. Congratulations on the new job.

And if it sounded as if I understand that I can ensure you that I don't.
Beautifully read Kate. Thank you very much well done. I wrote this. Its a muddle isn't it. Now you see this is trying to propose to you the muddle of real life. Now what is this an exercise in ? you could tell me that already.

Complexity.

Yes, exactly. Its an exercise not in accounting or man management because that's all taken out of it. But it's still very complicated. Is an exercise in complexity. Does anybody think that they could sit down hard and work on that they can solve it.

If I could I would have done it at my company.

Me neither.

I always put this to my undergraduate students and I offer a bottle of wine for the first person to give me the answer and every year for the past five years someone has done it. So there is a challenge for you.

Do we get a bottle for it.

oh yes.

Now what I am going to show you in the course of the days as a side line, as it were is how to solve this because obviously there are going to be ways by looking at this cybernetically, systemically that you can solve it. But I would quite like you to try if you are willing to just get the feel of it and tomorrow I will explain more about it. But please enjoy the fun. Because I'm not doing this to penalise you or be vindictive or something, I want you to see that real life is very complicated and that sounds very complicated. Actually it isn't, the question is, can you spot it and if so how? and are there techniques that can improve the matter? There you are. Goodnight.