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Cybernetics and organisational analysis; Towards a better understanding of Beer's Viable System Model

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CYBERNETICS AND ORGANISATIONAL ANALYSIS;
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Abstract

This paper describes a model - the Viable Systems Model - which purports to explain the more fundamental essence of what is required for effective organisation. The model draws on concepts from the science of cybernetics, and focusses on the fundamental objective of viability - the ability of a system to maintain a separate identity.

The paper provides a description of cybernetics appropriate to the needs of those with backgrounds in management and organisational behaviour, and is intended to guide practitioners through elementary VSM analyses of real organisations and diagnosis of cybernetic weaknesses. The paper also attempts to bridge the divide which exists between the so-called 'hard' and 'soft' disciplines which strive. to extend our knowledge about organisations and improve managerial practice

Key words: Organisational analysis, viable systems, cybernetics

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INTRODUCTION

> *"Is it conceivable that if we were to design (an) enterprise today, knowing its contemporary purpose, knowing also the managerial technology available through computers and other means, the enterprise would bear any resemblance to the organisation(s) we now observe."*
> Beer (1985)

This quote, taken from the sleeve of Stafford Beer's book ***Diagnosing the System*** (1985)[1,2] points to a paradoxical situation which is prevalent in many organisations today. Although corporate structures and processes are often genuinely designed to accomplish the purposes which form the *raison d'etre* of the organisation, all too easily they become a millstone around the corporate neck. Company structures and modes of operation which are a product of history, are rarely appropriate under changed circumstances. Performance deteriorates, often companies go out of business. Very occasionally they prosper in spite of their structures. They could probably do better.

This paper is about a model which purports to explain the more fundamental essence of what is required for effective organisation. Unlike most other approaches it does not pre-occupy itself with the multiple configurations of organisational structure which may be embodied in organisation charts, or various contingencies such as the size of the organisation or the technology it employs. In contrast, the model is concerned with a much more fundamental objective, for which the various aspects of a company's structure - organisation charts, job descriptions, operating procedures and the like - are merely the means through which this is accomplished[3]. The objective is ***viability***, the ability of a system to maintain a separate existence[4]. More will be said about this later. The title of the model is the ***the Viable System Model*** (VSM)

Stafford Beer, a management scientist with a strong interest in cybernetics, first developed the VSM 20 years ago. Since then it has been described in detail in three original works. These are *'Brain of the Firm'* in which he identified similarities between the way in which the human body and the firm are controlled and organised; *'The Heart of Enterprise'*, in which he built an organisation-oriented version of the VSM from cybernetic principles; and *'Diagnosing the System'*, a practical guide to the model. The details of these books are contained in the references listed at the end of this paper. It is not the intention here to rehearse the detailed descriptions which have been made in Beer's original works. However, there are good reasons for producing what amounts to a brief and fairly concise statement of its main features.

Firstly, there is a need to help those coming to cybernetics for the first time, especially those with backgrounds in management and organisational behaviour. Here, the aim is to help students to carry out fairly rudimentary VSM analyses of real organisations and diagnosis of cybernetic weaknesses, without having to come to terms with Beer's somewhat unique style and without ploughing through the detailed arguments and analysis contained in the original volumes. Recent experience has shown that such analyses and applications can be more than just learning exercises. They nearly always produce interesting and useful insights. Obviously, for more sophisticated applications or detailed consultancy projects, the reader is advised to read thoroughly and digest the material contained in the original volumes.

Secondly, there is the question of the academic division of labour. Today, especially for those with practical interests in business and management, there is a demonstrable need for a much more sustained flow of information across disciplinary boundaries. Nowhere is this more apparent than in the case of the divide which exists between the so-called 'hard' and 'soft' disciplines. To date it is remarkable that an essentially 'hard' field like cybernetics, which we believe says so much about organisations and their management, has barely penetrated even the surface of mainstream intellectual development in those 'softer' academic fields which purport to extend our knowledge about organisations and improve managerial practice. In New Zealand pioneering work on the VSM has been carried out by Graham Britton, Harry McCallion, their colleagues and research students from the School of Engineering at Canterbury University. This work should be available to a wider audience[5].

In what follows, the paper begins with a brief description of cybernetics and the concept of viability. This is followed by a description of the model itself.

CYBERNETICS

Many of the concepts which form the basis for Beer's development of the VSM are abstracted from the field of cybernetics. Before we move on to our description of the model there are a few cybernetic concepts which the reader uninitiated in this field needs to grasp.

Cybernetics has been defined as ***' the science of effective organisation - the science of communication and control, in the animal and the machine.'***[6]

Such a definition not only reflects the primacy of the role played by information in regulatory systems, but also reflects the existence of laws or principles of control that apply to all complex systems.

Alternatively cybernetics can be defined as the science of designing systems which have the capacity to self-regulate their behaviour to maintain a steady state in response to environmental changes. In practice therefore, attention nearly always tends to focus upon patterns of information, communication and control.

> The classic man-made example of a simple cybernetic system, which is often cited, is the 'Governor', two metal balls suspended from a device which rotates at the speed of a moving steam engine. Through centrifugal force, the faster the engine moves, in relation to a pre-determined norm, the more the balls move into a horizontal position. The effect of this is a reduction in the supply of fuel to the engine, thereby slowing it down.[7]
>
> A better known example is the thermostat-controlled heater. This simple cybernetic system is able to monitor changes in room temperature and regulate its own performance in response to user-set heating levels. The regulatory influence of the autonomic nervous system which acts upon muscle tissue and the organs of the body in response to changes in light, temperature, noise, and danger, provides a natural yet still relatively simple example of such a system.

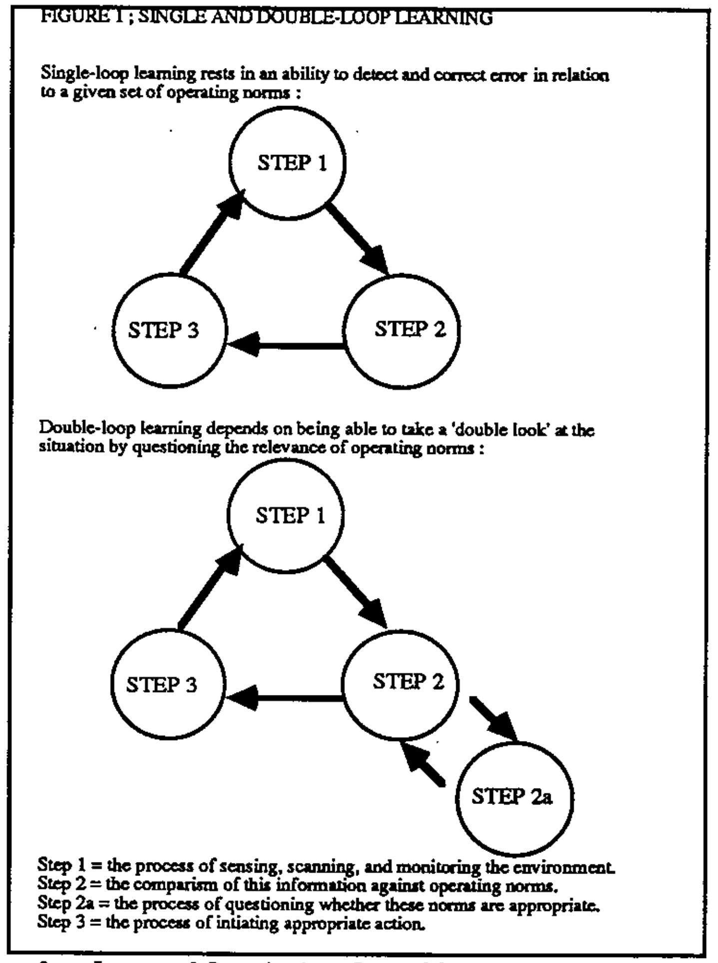
This ability to respond to environmental change, and take regulatory action to bring the system back into line with its pre-determined state, is often referred to as *single-loop* learning. Most organisations have a capacity to do this.

Unfortunately from the point of view of those with an interest in human activity systems like organisations, there are major limitations to the single-loop learning capacity of simple cybernetic models. Single-loop learning only allows the system to respond to environmental change in so far as it can detect and correct deviations from pre-determined operating norms. What they cannot do is question the appropriateness of these norms.

> The heater does not have the ability to reduce its set temperature because the occupants of the room have just returned from participating in a rugby match, or from taking the dog for a walk. The 'Governor' is unable to limit the supply of fuel to the engine when there is an obstruction on the track which requires the engine to reduce its speed.

This basic inadequacy of single-loop learning is the source of many well known features of organisational behaviour. For example, in highly bureaucratic organisations, operating procedures which are embodied in working procedures, company rules and regulations, or job descriptions, are frequently applied *as a matter of routine*, even in changed or new circumstances which render them totally innappropriate. Often this problem is compounded when individuals come to view the operating norms as ends in themselves, rather than as means to achieving other objectives.

On the other hand, there are some cybernetic systems which have a potential capacity for *double-loop* learning, in which basic operating principles **are** questioned in the light of changed circumstances (See Fig.1).



from Images of Organisation, Gareth Morgan, Sage 1986.p.88

The human brain for example stands apart from virtually all man-made systems in its ability to do this. One explanation focusses upon the extensive duplication of functions in the neurons which make up the brain. As neuro-physiological research has shown, different areas of the brain *specialise* in different activities, but the research has also shown that there is an element of *generality* within these areas[8]. In other words the brain has a 'holographic' quality in which (parts of) the whole is contained within each of the parts.

It is the spare capacity or 'redundancy of functions' which results from this duplication, which explains why, in physiological terms, human beings are able to retain a surprisingly large proportion of their memory and motor skills (albeit with less refinement of movement) despite the destruction of large areas of brain tissue. More importantly in cybernetic terms, it is this spare capacity which also explains why the brain is able to engage in self-critical and self-organising double-loop learning. For a more detailed discussion of this see Morgan (1986).

> The following analogy, albeit simplistic, may also be helpful to distinguish between single and double-loop learning behaviour. Suppose a basket ball team has one especially good player, perhaps an 'imported' American professional. The norm for the team's attacking operations consists of dribbling the ball down the court, getting the ball to the 'great player' and letting the 'great player' shoot. This system, which can be seen as a single loop learning process in which the problem is to score points, works fine so long as the internal resources of the team and the external environment remain constant over time. However we can be sure that they will not.

> What if the star has an 'off' day or is injured, or the opposition responds to this 'norm' by double-teaming him, or league officials decide to limit teams to just New Zealand resident players? If any one, or a combination, of these changes occur, then a single-loop system's inability to question the appropriateness of the norms, given the new situation, will leave it flummoxed.
>
> A system practicing double-loop learning may respond by questioning current norms given the changed internal and/or external environment, then adjust those norms accordingly. For instance, given the circumstance that their best player is heavily marked, the team may decide to occasionally pass the ball to other players who have more time and space to shoot. This forces the opposition (assuming they are a double-loop system) to challenge its own defensive norms.

The main point here is that while many organisations have become very proficient at single-loop learning - developing the ability to scan the environment, to set objectives, and to monitor the general effectiveness of the system in relation to those objectives - the ability to practice double-loop learning - to regularly question the appropriateness of those objectives - remains elusive for most[9]. Ironically, given the human brain's capacity for double-loop learning, it is perhaps surprising that a failure to act in such a way seems to be an emergent property characteristic of many human activity systems, particularly large organisations. It is our belief that Beer's representation of the organisation, in a manner which encourages participants to practice double-loop learning, offers a potential solution to this problem.

We now turn to the key concept of **viability.**

VIABILITY

In the introduction we briefly mentioned Beer's definition of systems viability as being its ability to ***maintain a separate existence.*** To accomplish this, the system must have the capacity to respond to environmental change, even if the change was not foreseen at the time the system was 'designed'. Here we find the link between Beer's concept of viability and double-loop learning. Complex cybernetic systems, with a capacity for double-loop learning, can respond positively to new circumstances because they are able to question, and then discard, inappropriate modes of operation.

In reality though, the extreme complexity and turbulence of the modern business environment creates problems for even the most enlightened managers. This is especially true in New Zealand and in other Western and Eastern countries, which have begun to reduce government intervention and regulations impacting on their economic and social environments, and whose economies and social systems are thus becoming more 'market driven'. The management of this complexity is seen as a key task in the management of any viable system.

Environmental complexity is a well-worn academic concept, especially in organisation theory, where several contingency models have scientifically explored its relationship with organisation structure. However, whereas many of these theories do not adequately address the notion of complexity, Beer provides a constructive operational definition.

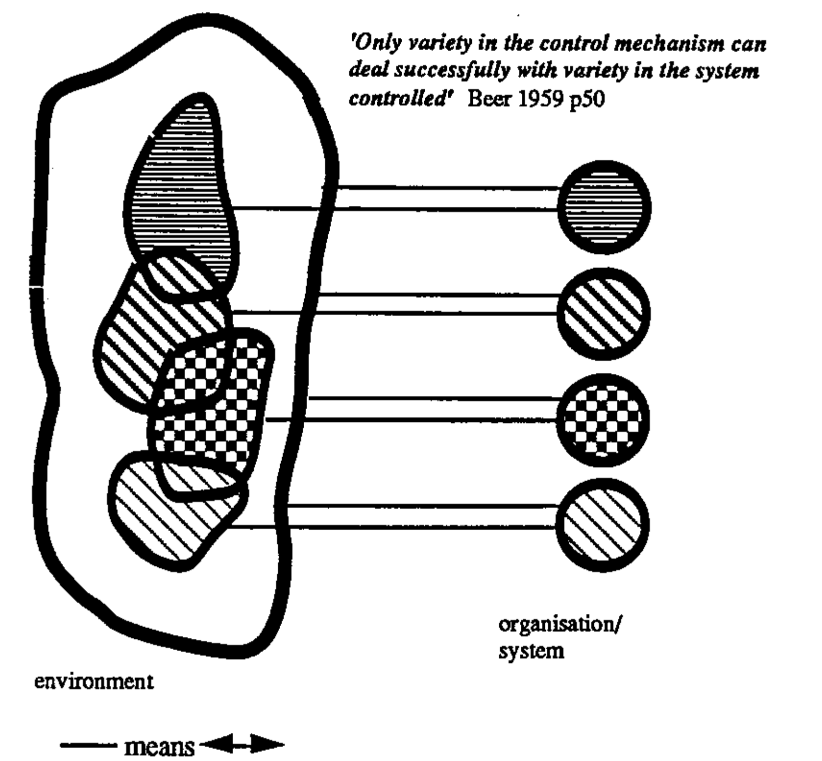
Following the cybernetician W.Ross Ashby, he adopts the concept of ***variety*** as a precise measure of systemic complexity. This refers to the number of distinguishable elements in a system, or, more relevantly,

> '. . .*the number of distinguishable systemic states*'[10]
> ' . . .*that have a bearing on the* <u>*purposes*</u> *of the system*'[11] (Beer 1979)

In order to become, or to remain viable, an organisation has to achieve ***'requisite variety'*** with its environment. This is true because according to one of the first principles of cybernetics ***' only variety can destroy variety'***. (Perhaps an easier way to comprehend this is to think in terms of 'only variety can absorb variety'[12] This is generally known as 'Ashby's Law', or 'The Law of Requisite Variety'[13].

> An animal can only remain a viable system (literally), if it has the capacity to respond to all the potentially dangerous variety states which its environment may display. Hence, the worm must be able to live happily underground, to avoid being eaten by the bird; the bird must be able to take to the air, to escape the cat; and the cat must be able to climb a tree, to escape the dog.
>
> Likewise, a large automobile producer in a market economy, in order to ensure its 'survival', must respond to the complexity of demand, within the environment in which it has chosen to operate, by producing more than one model of car. (It may be useful to refer to Figure 2 while working through this example). The automobile producer may have decided to provide for the mid-price family car market.
>
> Marketing and production have reached a compromise somewhere between what they believe the 'customer' in this environment wants, and what the company can logistically produce, based on policy objectives previously agreed upon.
>
> They may have decided to produce four models; a two-door saloon, a four-door saloon, a larger four-door saloon, and a two-door hatchback. Consequently four production units are set up, one to produce each car, and each unit produces its model for a corresponding 'local' environment. Note that these local environments overlap.
>
> This overlap may represent the fact that some people or groups may 'demand' more than one model. Alternatively, and no less importantly, it may represent the fact that suppliers of parts and equipment impact in more than one environment, as would Government regulations. The 'local' environment then is not made up of just customers, but all the factors outside the organisation that impact upon the production of the model in question.

FIGURE 2 : MATCHING VARIETY WITH VARIETY



Using the concept of variety as a measure of complexity should not be understood in terms of drawing attention to the dauntingly large number of states which the environment might display. Some are more likely than others. Moreover, if we refer back to the definition on the previous page, variety is perhaps best seen as a subjective measure, one which may only be defined in relation to some purpose.

> One important variety state for a soccer team is the brilliant skills and performance of the opposing side's goalkeeper. This is relevant for the simple reason that the goalkeeper is capable of thwarting the team's ultimate purpose, to score goals and to win the game.
>
> Similarly, as we have seen, the purchasing wants and behaviours of customers in the marketplace play a important role in the environment of the automobile manufacturing company which is looking to sell its products.

Admittedly, some see the concept of 'requisite variety' as being an inherently 'unexceptional fact'[14]. However, the counter-argument is that it is important, if only as an heuristic device, in which actual and potential balances between variety responses and various environmental states are examined[15] . This process, known as ***'variety engineering'***, may be accomplished in two main ways - through the system increasing its own variety ***('amplification')***, reducing that of the environment ***('attenuation')***, or through a combination of both.[16]

> Thus the cat can work on its speed, its agility, and ability to climb trees, (amplification), or it can avoid wandering into the garden where the dog lives (attenuation).
>
> The Auto manufacturer through its marketing strategies may seek to do both; it can impress upon potential customers that the features of the models offered satisfy a wide range of different potential customer groups needs (amplification), or target the marketing campaigns for each model to carefully focussed groups of 'targeted' potential customers (attenuation).

Exactly how such a task is accomplished in organisations will vary according to circumstances. However, because of the complexity of modern environments, there is always the possibility that environmental variety will completely overwhelm management, unless 'variety engineering' in some form, either consciously or unconsciously, takes place.

THE VIABLE SYSTEMS MODEL

Beer's belief that ***'the most useful characterisation of an enterprise is as a viable system.'*** [17] requires that a theory of 'effective organisation', a cybernetic theory, must establish **internal** criteria of viability. His approach has been to demonstrate that certain features of a system are necessary to its viability, and then to eliminate features of viable systems, which do not appear to be essential to survival[18]. In a nutshell, he conceptualised the notion of a viable system, as divided into a 'logical hierarchy' of two parts - the system of operational elements, which exist to undertake the systems' basic activities, and a collection of 4 sub-systems, ie. a Meta-system, which exist to 'look after', to 'regulate' or to 'manage the system of operational elements; all five systems, being in 'intimate connectivity', through information, communication and control links[19].

Beer therefore does not follow the line taken by the classical management scholars, who often attempt to prescribe a particular organisation structure to be followed in all cases, or by contemporary theorists who relate structure to various contingencies. Rather he believes that in order to exhibit 'good cybernetics' there are a number of necessary component systems (Systems 1 to 5) and important information and control links between them, which are present in all viable systems, and need to be developed in those which are not. These 'systems' should not be thought about as being necessarily embodied in a structural form. Although unlikely in practice, there is no reason in principle why the systems listed below have to take the form of departmental units, a hierarchy, formal channels of communication, or job descriptions. The model is one of ***systems viability***, in which Beer attempts to help us better understand how systems are capable of independent existence. It is vitally important that the model is not construed as a theory of organisational structure or design.

This section begins with a brief summary or definition of systems 1-5 followed by a more detailed description of each and the links and relationships between these 'parts of the whole'.

FIGURE 3 : SUMMARY OF SYSTEMS 1-5

SYSTEM 1 Primary Activities[20]	SYSTEM 2 Coordination	SYSTEM 3 Control	SYSTEM 4 Strategic Mgmt. Intelligence	SYSTEM 5 Normative Mgmt.
Produces the Viable System[21,22]		'Here & now' Control function, Day to day Management[23,24]	'Outside & then' Intelligence fnct[25] Change & future[26] Deals with the more comprehensive environment and the long term[27]	Ultimate authority [28]
Responsible for implementation[29]	Acts to solve problems between elements of System_1[30]	Responsible for internal stability[31]	Instigates changes and 'development work'[32]	Responsible for 'policy'[33]
Absorbs local variety[34]	Acts to prevent oscillation[35,36] Ensures elements making up S1 act in harmony[37]	Responsible for the anti-oscillation function of S2[38]	Provides self-awareness for the SIF[39]	Provides 'logical closure', 'completes' the system[40]
Autonomous[41]	Dependent on S345 since they deal with the whole of S1[42] S2 activities preserve some local (S1) autonomy[43]	Conducts resource bargaining with S1 [44] Delegates authority & accountability to S1s[45]	Decision-making 'operations room'	'Masterminds' the 3-4-5 meta-system[46] Creates 'corporate ethos', [47] provides norms[48]
Uniquely has the capacity to survive independently[49]	Acts to determine priorities & to timetable requests for service from S1[50] Comprises info systems necessary to decentralised decision making within System 1[51]	S3* guides & audits S1 performance sporadically by agreement with S1[52] Can exert authority through the central command axis[53] Channel for orders relate to S1 opns[54]	Disseminates info up & downwards	**Integrates** different viewpoints[55] Must represent the essential purposes of the system to ensure viability[56].
Fundamental to the viability of the SIF[57]			Acquires 'criteria of relevance' from S5[58]	Provides 'criteria of relevance' to S4[59]
A Viable System itself.[60,61] Has its own local management and exhibits each of the 5 systems			Models future and present total environment, the whole viable system & models itself[62]	**Mediates** between internal & external environments, **balances** 'today's' operations with 'tomorrow's' needs[63] ... by means of norms[64]

SYSTEM 1

The system that is being studied is referred to as the System-in-Focus (SIF). System 1 of the model refers to the operational elements of the SIF, specifically those which can be said to 'produce' the system[65]. The easiest way to think of what, within the SIF, constitutes a System 1, is to consider 'what the system does' in the sense of its basic *'raison d'etre'*, and then to identify the various units which directly carry out these activities.

> If we take as our SIF the Auto manufacturer mentioned as an earlier example, its *raison d'etre'* must be to produce automobiles. Referring to the previous section, the sub-systems which do this are the units diagrammatically described in Figure 2 which produce the different models of car.
>
> Alternatively if a university is studied as a SIF, its System 1 would be comprised of its discipline-based teaching departments, its graduate business school, and its various research units. Following the logic applied to the auto manufacturer, the university's basic *raison-d'etre* is to provide students with a teaching service and to create knowledge. This is not to say that these are the only reasons why it exists, or that the stated activities may be conceptualised in terms of operational 'organisational goals'.

Beer makes another vitally important point about System 1. He believes that System 1 units should be autonomous and themselves potentially capable of independent existence. Because of this independence and autonomy ascribed to System 1 units, they also may be conceptualised as viable systems[66]. Each System 1, therefore, will exhibit, or be comprised of, 5 'nested' basic component systems, at a different level. This multi-level feature of the model is known as ***recursion***. It will be considered in some detail later.

Because these original 'embedded', or 'nested', System 1 units are expected to be viable systems themselves, there is no reason why they could could not be 'hived-off' ie. sold as 'going concerns'. This is a key criterion which Beer uses to differentiate between System 1 and other activities.

> In contrast the auto company's accounts or research and development sections or the university's computer support service could not be conceptualised as System 1 activities. Doubtless neither the company nor the university could operate without them, but they are not viable systems, they do not 'produce' the organisation, they are not directly carrying out the activities which capture the essence of the organisation's *raison d'etre*. Their functions are to facilitate operations in the same way that the circulatory system in the body supports the key organs, heart, brain, lungs and so on. Neither could take their ***present activities*** and operate independently. To do so would require a major change in orientation, for example the computer support service taking on a profit-oriented bureau or consulting role.

Importantly therefore, System 1 components should not be defined solely in terms of departmental, or functional, distinctions suggested by the traditional organisational chart which also emphasises the hierarchy of command and dependency. There is, though, an important proviso to make in all of this, and it is to do with how one conceptualises the original SIF, the Viable System itself.

One of the basic dangers in applying the VSM to real organisations, and defining a SIF, is that one can easily become overly constrained by the actual 'corporate' boundaries of the organisation, or its sub units, as embodied in its organisation chart. In our view there is no reason why this should be the case.

> To illustrate this point let us again take the case of the university. We have shown that by identifying the whole university as our SIF the computer support service (CSS) does not satisfy the criteria of a System 1 activity. The university does not exist to provide computer support, it exists to provide a teaching (and other) service(s). In its present form the CSS could not be sold as a going concern, it is not a viable system in its own right.

> However our conceptualisation of the CSS, our thinking and theorising about it, does not have to be constrained within the *actual* organisation structure of which it is a part. For example, there is no reason why we should not take the SIF as the 'University Support System'. This may not be manifested in any particular organisational form but for our purposes it is entirely reasonable, and if we want to know more about such activities, it is probably very interesting.
>
> In this case the CSS *is* conceptualised as a System 1 activity, because it does what the system is designed to do, that is provide support. In theory, therefore, there is no reason why it should not be sold as a going concern. Because the rest of the university - including the teaching departments - is not encompassed within the *defined* SIF, logically it can be thought of as part of the environment. This is an important point to grasp.

In order to understand why System 1 components must be capable of independent existence in their own right, we refer back to the question of variety. Here, Beer's argument is that higher management is generally incapable of handling the massive (localised) environmental variety which System 1 components face[67].

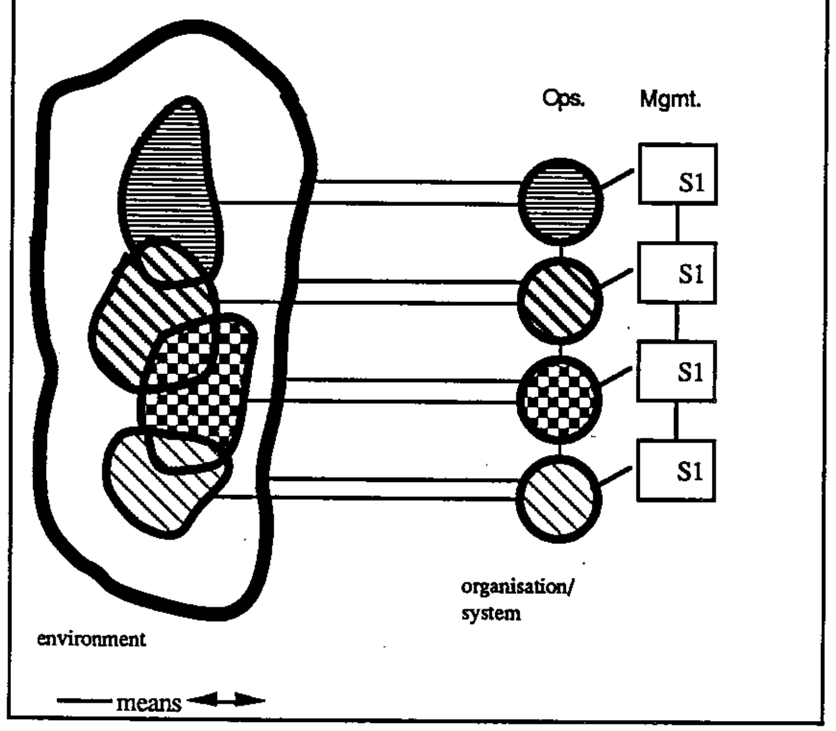
> For example senior university officials cannot possibly keep abreast of academic developments in all of the disciplines which are taught within the university. These emanate from within 'localised', environments, albeit ones which have exceptionally large international boundaries. It is individual members of the academic staff, carrying out System 1 roles, who interact with these 'localised' environments. This they do by attending conferences, reading specialised journals, joining professional organisations, and so on.

Because of the complexity of these localised environments, variety can only be absorbed by granting autonomy to System 1[68]. Failure to do so, leads to a situation in which opportunities, or threats, are not dealt with at the point where they occur. Problems, like poor quality work, for example, are not dealt with at all and become an institutionalised norm, or (typically) they are seen to be part of the domain of those occupying specialist or advisory roles eg. the quality control department.

More generally, a failure to grant sufficient autonomy to System 1 leads to higher management levels becoming overwhelmed, and to a loss of control. It is for this reason that System 1 components must be granted sufficient autonomy to absorb local variety.

System 1 units can be expressed as two parts, S1 'operations' (the 'circles' in the organisation/system in Figure 2) and S1 'management' (incorporated into Figure 4 as the 'boxes' linked to S1 operations). Note that the various units of System 1 have a line linking them. This represents communication between them and should be viewed as arrows flowing both ways.

FIGURE 4 : SYSTEM 1 - Operational and Management elements



The reasons for communication between the sub-units should be obvious; these should help to stem such undesirable circumstances as competing unwittingly for the same potential customers, or failing to realise economies of scale, through combined purchase of raw materials. The lines may also represent the flow of products and/or raw materials which would occur in a vertically integrated production process.

SYSTEMS 2, 3, AND 3*

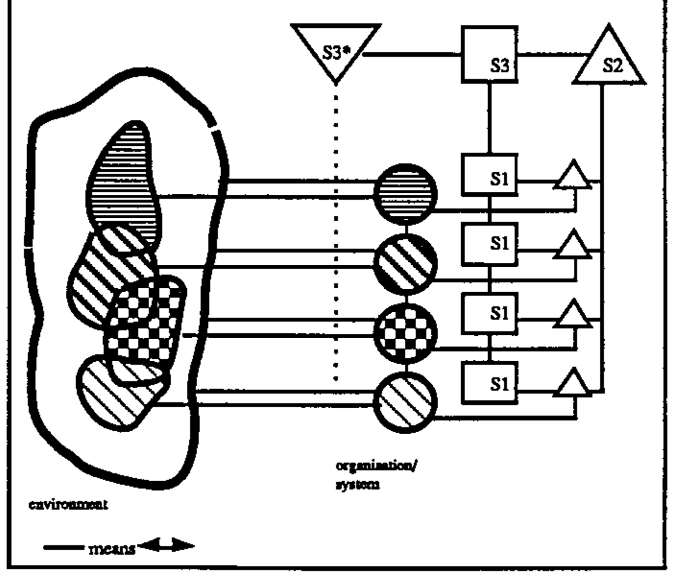
The reader may now be questioning, in their own minds, the notion that there should be a concession of autonomy to System 1. While this sounds fine in theory, many management practitioners will see the adoption of this as a recipe for anarchy unless there are adequate provisions for co-ordination, and also some form of 'accountability' for, and within, System 1. It is important to grasp the point that autonomy does not mean no interference at all. It is the interface between Systems 2, 3, 3* and System 1, that, in the VSM, provides the scope for negating the 'dangers' of autonomy mentioned above.

SYSTEM 2 performs a coordination function. This is required due to the independence and autonomy allocated to System 1 units. Without coordination, the legitimate self-interested activities of these units could lead to disharmony, particularly in situations in which they compete for scarce resources. Wide discrepancies of production standards amongst the car producing units, or withholding or hoarding of resources by one unit, when their shared use may be beneficial to the system as a whole, would be examples of what Beer calls **'oscillation'**, and indicative of a failure of System 2. In all viable systems therefore, there is a need to minimise harmful negative interference between operational activities. System 2 provides this. Because each unit of System 1 will have its own spheres of possible oscillation, each interacts with its own unique local System 2, which comprises a subset of the overall System 2 function.

SYSTEM 3 is a control function which is responsible for the internal stability of the organisation. It is responsible for the planning of System 1 known as Resource Bargaining, and for which resource allocation is one outcome[69]. In addition, it outlines the methods by which organisational policies will be implemented, and also sets standards/criteria for S1 to demonstrate accountability for its actions.

Thus, on the other side of the resource bargain is the accompanying need to periodically monitor and 'audit' System 1's performance with the resources allocated. This is required to ensure that System 1 is effectively implementing policy which has descended from higher levels in the organisation, and to ensure that the actions and behaviour of self-interested operational elements are not compromising goals set by policy makers. This 'auditing' function is represented by **SYSTEM 3*** (Three Star).

FIGURE 5 : SYSTEMS 2, 3, AND 3*



THE 2, 3, 3*,1 INTERFACE

Beer's (1990) major criticism of both Western and Eastern economies, is their destructive emphasis on centralization[70]. Many would argue that this is also a problem common to many organisations in New Zealand today. He argues that centralization has developed as an attempt to give 'higher' levels of management more cost effective control over 'lower' levels of the organisation. Two diagrams are given here to illustrate this 'flaw'.

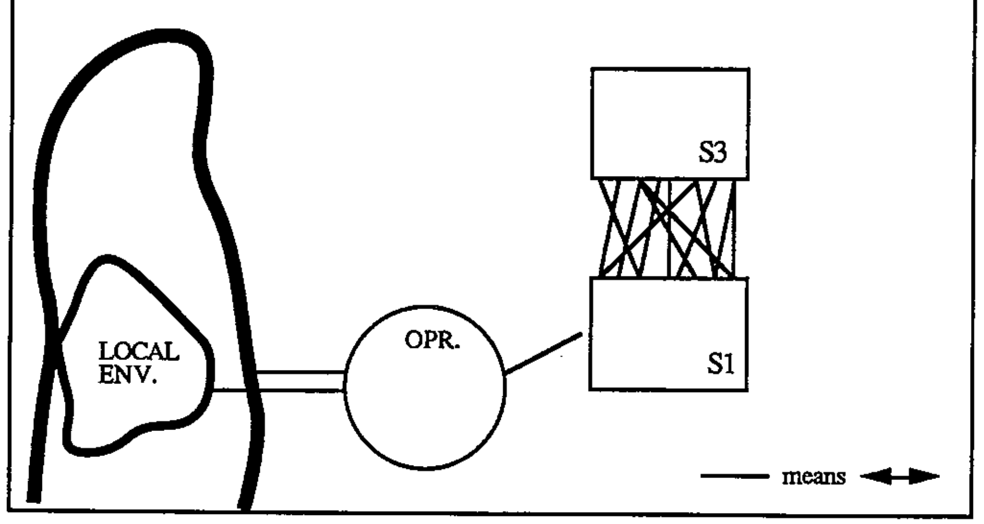
Figure 6 uses VSM conventions[71,72] to illustrate typical management methods of conveying information, monitoring, outlining methods, goals and objectives etc. for 'lower level' business units (S1). Much time and effort is spent transmitting this information. A frequent criticism of centralization is that it can create excessive bureaucracy. One can easily imagine a bureaucratic response emerging to enable the system to cope with the volume of work generated by the links between System 3 and System 1.

The reason for the many links is understandable. The performance of higher level management is often based on the performance of the lower operational levels. Thus they have a vested interest in the way System 1 works. To be in control of their own destiny, they perceive it necessary to 'control' these lower levels. This is often particularly true in situations where higher level managers have themselves been promoted from System 1.

In cybernetic terms, System 3 managers seek to impose their own 'variety' on the business processes of the 'horizontal slices' of System 1. This amounts to a 'collapse' of System 3 into System 1, a scenario which can lead to the following problems:

> i. Higher level management becomes overloaded. It devotes unnecessary time to 'lower level' management activity, perhaps at the expense of performing its own tasks.
>
> ii. Poor local environment scanning, as these managers are too far from, and do not have the time or resources to understand, the local environment 'coal face'. These responsibilities should be dealt with by System 1 management.
>
> iii. Each of the above behaviours can result in ineffective 'variety offerings' from System 1 to its local environment, eg. customers, suppliers. These stakeholders may become be dissatisfied with what the organisation is producing.

FIGURE 6



Matching Horizontal Variety With Vertical Variety

Within the framework of the model developed so far, communication in the system basically operates in two ways; horizontally, with suppliers, customers, and the environment; and vertically, with other members of the organisation. Generally speaking, organisations generate 'earnings' on the horizontal axis, and 'spend' on the vertical axis. While the vertical functions are necessary to put the business in a fit state to 'earn', they do not directly 'earn' for it.

To avoid the occurance of the cybernetic deficiencies listed on the previous page S3 management must realize the limitations of the variety it is able to absorb. S3 should seek no more quality information (information rather than data) from its S1 units than its capacity allows it to cope with. Refering back to Figure 2 the sub-system S3 must seek to match its variety with the variety of information flowing from its environment, ie. the S1 units.

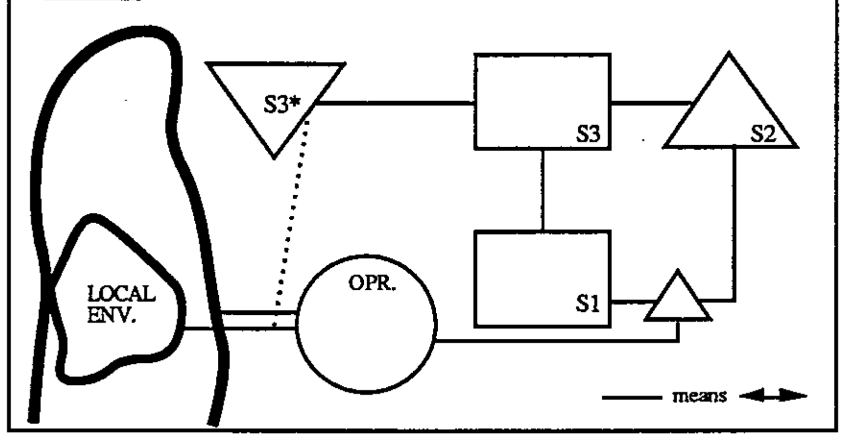
S1 units need all the variety they can generate, in order to function effectively on their own individual horozontal slices of the total organisation[73]. Producing a less bureaucratic alternative to the situation shown in Figure 6, would free up the management of System 1 units so that they can concentrate on their horizontal tasks and thus 'earn' for the organisation; would free up higher level managers so they can concentrate on their roles of 'running' the organisation as a whole and thus reduce costs; and would provide some form of control and co-ordination to keep everything 'on the rails'.

Figure 7 demonstrates how the VSM seeks to offer a solution to these problems[74,75]. In the short term it is probably unlikely that one will be able to alter the belief of many managers that they need to have some form of control over the organization's operational units. What may be more effective is to change their perception of what constitutes 'control'.

Cybernetic Control Processes[76]

Control processes can be simplified into two forms, enabling procedures and auditing. There seems no reason why either of these two functions need interfere greatly in System 1 managers' work. Figure 7 illustrates how these functions can be spread horizontally so as not to distract System 1 managers from their work - the horizontal task of 'earning'. The System 3* function of auditing can, and should by definition, be carried out after operations have taken place.

FIGURE 7



In this context 'auditing' should not be defined as merely an accounting procedure which is carried out after a specific period[77]. Certainly, it includes this, but also it includes all of the mechanisms which enable workers within System 1 to question whether the tasks that have been performed have been done so in accordance to the set guide-lines. Moreover it is not desirable to act blindly first and question what has been achieved afterwards. 3* auditing is an on-going process.

If a proactive approach to this is adopted, perhaps by clearly defining 'the way we do things around here', and then communicating this to members of the organisation at the various levels, operational managers should be able to react to situations as they occur, without constantly consulting their senior colleagues.

Figure 7 illustrates how System 2 can be used to represent these retroactive and proactive 'oscillation prevention' functions. Staff training and induction programmes, or pricing policies would be a good examples of the practice of this. Obviously, a balance needs to be found, between setting appropriate guidelines and monitoring performance, at a level which allows enough scope for **innovative** action on the part of System 1 managers. Hence, in complex environments, guidelines must not take the form of highly sophisticated networks of rules and regulations which provide instant answers to all the problems that occur in the various horizontal slices. These managers must be allowed to think for themselves, and use the superior knowledge that they have of their own local environments, to fill in the gaps and provide their own answers within the broad guide-lines set.

Double Loop Learning Revisited

The viable system must also have the capacity to question the 'appropriateness' of the guide-lines conveyed by System 2. Remember that the environment in which an organisation is operating is dynamic. Thus the 'way we do things', at present, will not be appropriate indefinitely. The link between S1 operations and the S2 functions must be two-way. If those in operations, based on information received from their local environment, perceive that the 'guidelines' are no longer appropriate, they must have the capacity to question these and suggest changes[78].

As long as a suggested change remains within the policies articulated by higher levels of the organisation, and is not inconsistent with the practices of the other S1 elements, then suggested changes should, in some form, be agreed to. This is based on the premise that it is the S1 units that best know how to serve their local environments.

> The concepts and practice of 'quality circles' or 'focus groups', popular in many organisations today, are ways in which organisations can, and do, carry out this 'double-loop' questioning process.

The Central Command Channel

There should also remain some direct link between the System 1 and System 3. While it is desirable to give S1 personnel as much freedom as possible, situations will always arise, given the complexity of the environment, where those in S1 will wish to seek direct guidance from S3 about what, given the circumstances, would be the best way to act in order to pursue the organization's best interests. S1 personnel should not be discouraged from this. While those from higher levels of the organisation should not be seen to interfere they should remain accessible. If S1 people feel uncomfortable about making contact with S3, or think it an impossibility, due to a perception that S3 personnel are not available or empathetic, then negative consequences will arise[79].

A Cybernetic Approach To Performance Monitoring

On the question of performance monitoring, Beer is critical of the accounting-based criteria which are routinely applied in many organisations. He believes that over-emphasis upon profits, sales revenue, costs etc, to be unnecessarily limiting because they rarely take into account other factors which are vital to the future viability of the organisation. Instead he proposes a more comprehensive set of performance criteria[80].

These are:

- **actuality** - a measure of ***actual performance***, **given existing resources**, under existing constraints;
- **capability** - a measure of ***potential performance***, **given existing resources** & constraints;
- **potentiality** - a measure of what is ***possible*** **by developing resources** and removing constraints, although still operating within the parameters of what is possible.

The ratio of actuality and capability is defined as **productivity**

and that of capability and potentiality as **latency**.

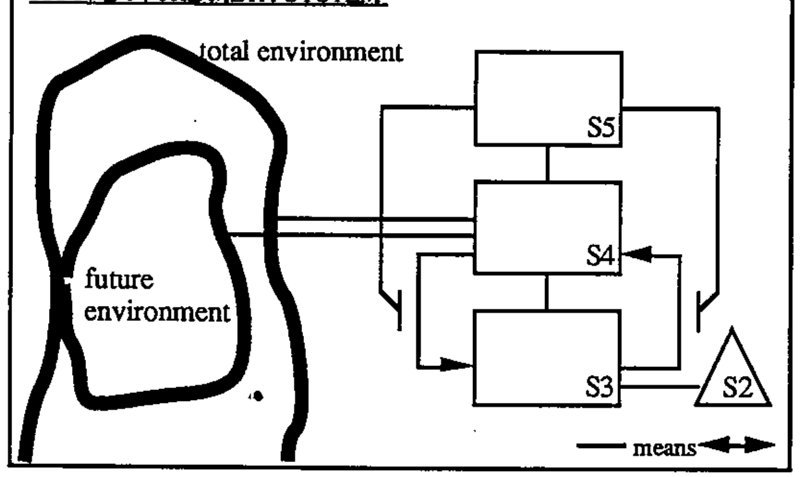
The product of latency and productivity is defined as **performance**
and provides an overall measure of achievement

SYSTEMS 4 AND 5

This section considers how the policies and procedures mentioned in the previous section are developed and from where they emanate. The capability for Systems 3, 4, and 5 to develop an integrated overview of the organisation and the environment, provides the present and future direction of the organisation.

Collectively Systems 2, 3, 4, and 5 are called the Meta-System. They exist to manage the collection of S1 operational elements so that they cohere in the totality we call the viable system[81]. (Meta in Greek meaning 'over and beyond'). This is shown in Fig.8[82].

FIGURE 8 : THE META-SYSTEM



Whereas System 3 performs an 'inside and now' role[83,84] **SYSTEM 4** responsibilities are concerned with the 'outside and then' of the organisation[85]. Its role is to collect and analyse salient information from the organization's total (not localized) environment present and future. This may involve functions such as market research, product development and corporate planning activities. System 4 interacts with System 3 to decide the specifications of what the organisation will produce. This may require a compromise.

> For example if we return to the Auto producer; the marketing department's research may lead it to push for six models to be produced on the basis of research which indicates that six models are necessary to 'satisfy ' the market. System 3 managers prefer to keep production to four models as an increase would require a reorganization of resources and thus increase costs.

However, some evaluation will have to be made to determine which alternative, or compromise, best fits with the organization's policies or strategy.

The organization's corporate strategy may read ;

> *It is our aim to provide the 'family' car market of New Zealand with a wide range of quality car options to meet all the needs of a modern environment at a reasonable price.*

> The marketing manager may argue that six models are needed to accomplish this objective. The production manager may counter that the existing range adequately satisfies this criteria and to offer more models would mean the organisation would not be able to produce them at a reasonable price.

The consequential questions then revolve around who decides what is the correct interpretation of 'policy' given the current situation; and who decided upon the strategy in the first place. In Beer's model this is **SYSTEM 5's** function[86].

System 5 then, is responsible for policy setting. It accepts responsibility for the development of agreed purposes, which serve the function of binding together the various system components. It responds to information or feedback sent to it from the other systems, and it arbitrates between the internal and external demands represented by Systems 3 and 4 respectively. The policies developed by System 5, provide the basis for the development of the guide-lines which manifest themselves in System 2. Thus all the sub-systems interact in a dynamic process to determine the system's direction, but, based on the information which they provide, it is System 5 ultimately that provides the system as a whole with its 'identity', and makes final decisions regarding direction.

From a strategic management perspective, the development of strategy should involve a combination of three factors[87].

1. What does the market want ? (S4)
2. To what extent can the organisation's resources produce it ? (S3)
3. How does its production fit with the 'culture' of the organisation ? (S5)

The figures in brackets show the association between the 'factors' and the systems we have been describing.

CHANNELS OF COMMUNICATION AND INFORMATION FLOWS

It is important at this stage in our discussion to acknowledge the importance of the links between the various sub-systems which we have described. Even if all five of these sub-systems are present and effective ***within themselves***, the system as a whole cannot function effectively unless the various channels of communication between the sub-systems have been established and are maintained. Once these channels have been established, it is important to ensure that the information flowing between two or more sub-systems is presented in a form which will be understood by the receiver. The cybernetic term **transducer**, meaning ***'leading across'***, is used to describe the means by which this is accomplished.

> The implementation of a new computer system throughout an organisation will have implications for many different departments. Each of these departments will have different needs, which will be communicated using their own *language*. In some instances specialists from different departments will make use of highly technical language, or jargon. For the new system to work effectively, a 'translation' process must occur in which the technical language is encoded in a form which is more readily understood, or decoded, by those without specialist knowledge.

Moreover the channels of communication and the transducers which occur between systems, must also satisfy the Law of Requisite Variety, ***'Only variety in the control mechanism can successfully deal with variety in the system controlled***[88]***'***. This means that channels of communication between systems (internal and external), must have sufficient variety capacity to deal with the information which they convey, and transducers must have the variety to accurately convey the meaning of messages. The achievement of this, of course, is an ideal which is unlikely to be fully accomplished in practice. Real-world transducers rarely posses the ability to perfectly convey the meaning of messages from one system to another. Beer (1979) cites the case of translation as an example of this.

> 'The fact is that they (the translater) do not have requisite variety as transducers. . . this is not a problem of of 'translation' as such, . . . It is . . . a problem of requisite variety. The translator is a perfect linguist. But does the translator personally comprehend - not my words - but the number of possible states that I intend to evoke by my words? No: neither he nor she, in my experience, deploys that much variety'[89]. .

THE SELF-IMPORTANCE OF SYSTEM THREE

It has probably been noticed that System 3 has featured in both of the systems groupings that have previously been discussed. System 3 can therefore be considered a lynchpin between the present and the future[90].

(5 - 4 - 3)

(3 - 2- 1)

It is, perhaps, because of this fact, that many of the functions which can be associated with System 3 activities, can see themselves as running the organisation. Frequently an explosion in bureaucracy is the result. It is important to remember that it is the output of System 1 which provides the rationale for the existence of the other sub-systems, especially System 3[91]. It is System 1 which actually does what the system as a whole is supposed to do, the other systems only think about doing it.

LEVELS OF RECURSION

Earlier in our discussion of System 1, it was noted that it may be seen as a viable system in its own right, having the capacity to manage its own affairs and match the variety in its own local environment. This means that within each System 1 of the SIF, there occurs another viable system with exactly the same characteristics, or logical structure[92]. Diagrammatically this is shown in Figure 9.

Here the large square and circle represent the original operational and managerial elements of each System 1 element in the complete model.

The smaller figures encompassed within the larger shapes, show the complete model within the original System 1 boundary. This demonstates its autonomy and viability, as a system in its own right.

Moreover just as the SIF can be partitioned into smaller viable systems, so too can it be seen as a System 1 of a larger system[93]. This multi-level characteristic of the model can be described using the mathematical concept of ***recursion***, or using the everyday concept of 'nesting', illustrated by the familiar Russian Verushka dolls, or Chinese boxes[94].

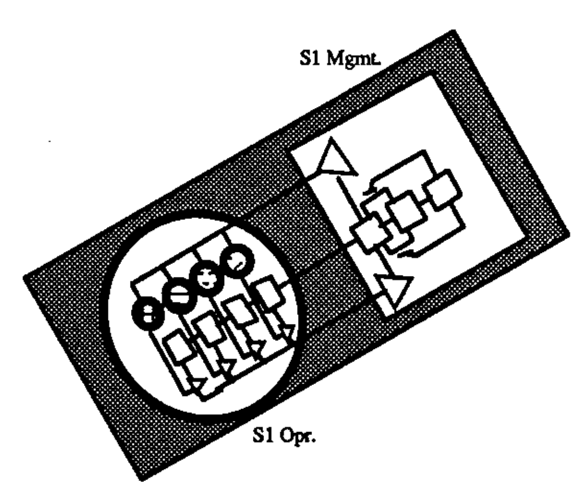
Potentially, there exists an infinitely large number of possible levels of recursions.

> If we are dealing with natural systems, for example, there is no reason why we should not focus upon any unit from the individual atom or molecule at one extreme, to the whole of the universe at the other. Of course, in practice, specific but appropriate recursion boundaries will have to be drawn, in order to make the project manageable[95].

System 5 has been identified as 'masterminding' the meta-system called 3-4-5, the 'outside and then' management[96]. Its main function is to monitor what Beer calls the 3-4 'homeostat', ie. to provide a balance between the current operations and internal stability, and the long term outlook of the organisation.

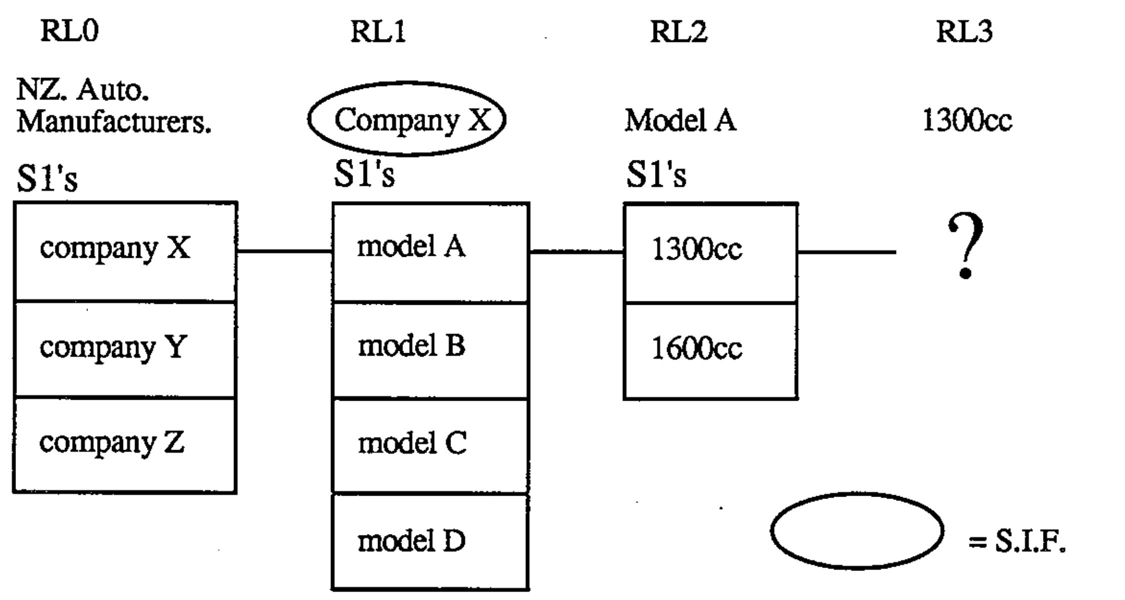
System 5 also provides a mechanism for the assertion of identity, for self-reference, and therefore provides what Beer calls 'logical closure' to the viable system at the level of the SIF[97]. However, this viable system can still be recognised as the same identity within a larger system, indeed a larger viable system within which it can be regarded as a single System 1 operational unit. 'System 6' therefore, is always the larger embedding viable system.

FIGURE 9 : RECURSION



We can illustrate this using our earlier example. VSM convention dictates that the SIF should always be conceptualised as recursion level 1. Hence the SIF Automobile producer exists at RL1, the model A unit RL2. The model A unit may be able to be further divided into say 1300cc and 1600cc, these systems would exist at RL3. An RL0 could be New Zealand Automobile Producers, it could also be New Zealand Manufacturers, higher recursion levels will often be a matter of interpretation. This is demonstrated in Figure 10. The company we have been using as an example is called Company X.

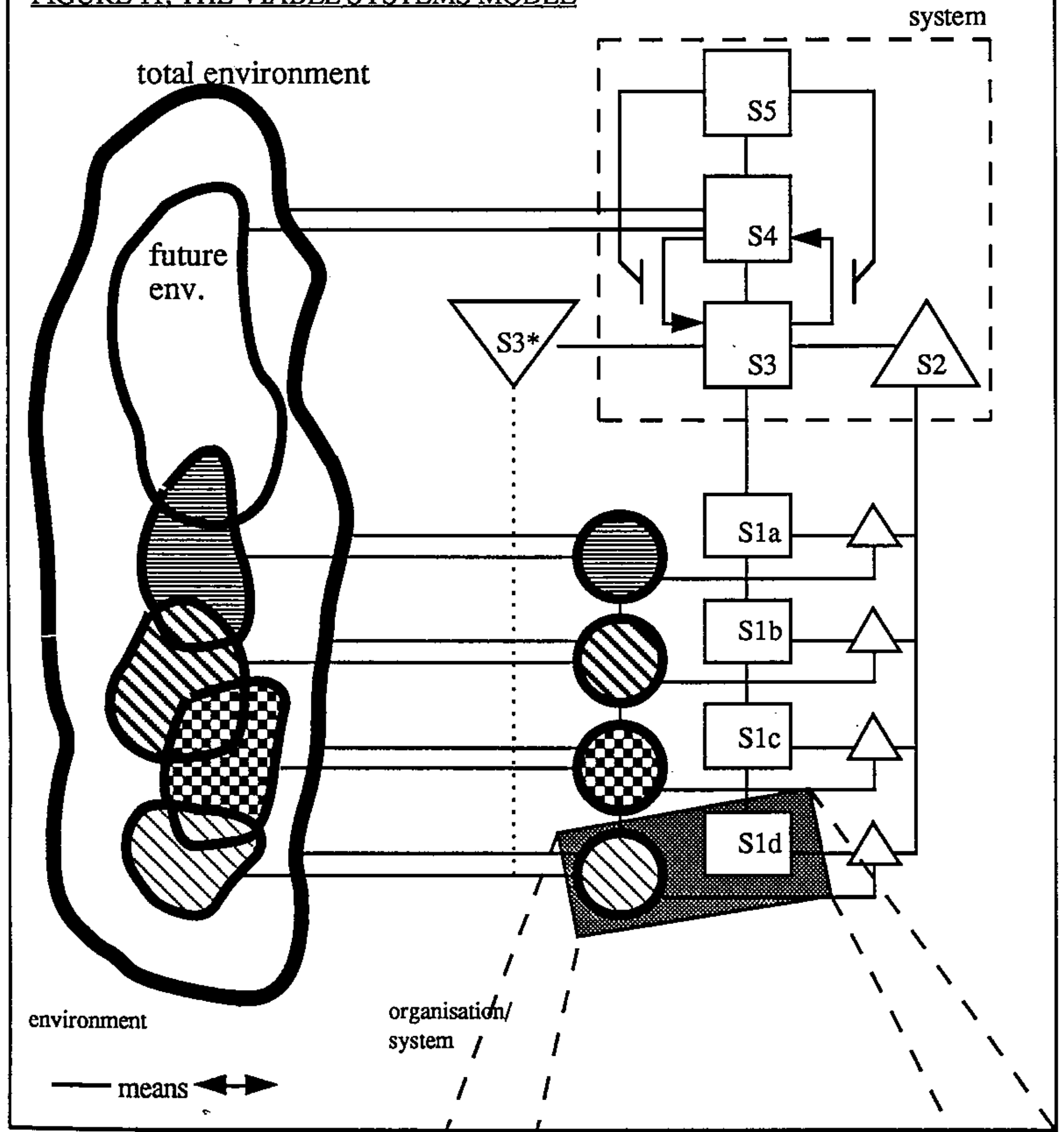
FIGURE 10: LEVELS OF RECURSION

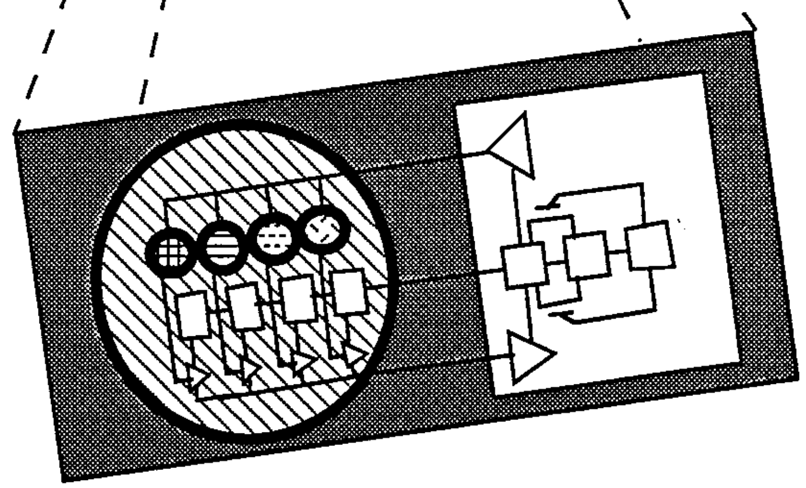


It is useful, once you have decided what you wish your SIF to be, to map out levels of recursion in order to generate a picture of the relationship of the SIF to its corresponding greater and lesser systems. All systems should act in harmony with those at the same level and above and create a harmonious environment for the systems it comprises to act within. One level above and one below is the norm.

We are now in a position to show diagrammatically the entire VSM. It must be stressed at this point that its geometrical shapes are not meant to appear as rigid boundaries for each sub-system, they are merely a diagrammatic convention. Systems are often holistic in their nature, and the precise placement of their many parts cannot always be placed neatly inside boxes.

FIGURE 11: THE VIABLE SYSTEMS MODEL





A NESTED VIABLE SYSTEM

Illustrating the concept of ***Recursion***

CONCLUSION

This paper ends on a similar note to that on which it began; the way most organisations are structured today is more a product of history than of any attempt to satisfy the increasingly complex and dynamic environments in which they operate. It is, of course, the environment of an organisation which provides the seed-bed and germinating conditions for its existence. If members of organisations seek on-going viability they must begin to take a long hard look at the way they organize themselves in relation to their environment.

At this stage, it is important to reinforce a point made earlier. Personal experience in using the model, teaching it, and discussing it with others has convinced us that one must continually guard against holding it up as the ultimate expression of what organisation and management are all about.

When some particular organisational reality fails to measure up against the benchmark of what looks like a fairly neat and tidy electronic circuit board, there is a real danger in believing that it provides a ready-made blueprint for change, to which all and sundry will surely be committed. All that needs to happen is for the various individuals involved to 'see the light', in the process of which they are expected to share the cybernetician's enthusiasm and perhaps undergo something akin to an evangelical religious experience. The danger in this is what Lynda Davies (1990) refers to as the 'seductive' quality of systems models, a trap which must be avoided at all costs. It does not provide a suitable basis upon which to carry out applied research.

In its defence, the key point to make is that the VSM is a ***model*** of systems viability. It provides us with a language and conceptual picture of a system which is capable of on-going independent existence in a changing environment. In theory, the cybernetic logic of the system will allow it to work. Of course there is a world of difference between theoretical models of systems and the real thing. This limitation has to be recognised. As Davies (1990) puts it

> ***' . . . (there is a danger of us) holding a stick diagram of a tree against awesome, terrible, beautiful landscapes and worshipping the stick diagram as our salvation'***[98].

Providing those involved, realise that stick diagrams and circuit boards can never provide a true and complete picture of that which they seek to represent, such schema are still immensely useful.

The VSM is a simplified and macroscopic representation of reality, and as such cannot define all of the complexities of humans and their interactions with others and the earth. Whilst there are many models of organisational reality, it is our belief that this is an extremely well developed and useful one. It provides a framework, on its own, or in conjunction with other models, for organisations to begin taking the 'long hard look', or it can merely provide some interesting insight and material for discussion about the reasons for successes and failures within the organisation to which it is applied.

Specifically though, the VSM is not meant to represent an organisation in any formal sense, nor does it provide a direct image or picture of the organisation in the way that an organisation chart portrays the hierarchical command, authority and dependency relations between the various individuals and groups in a company[99]. Furthermore, the schematic representation of Systems 1 to 5 as a logical hierarchy can be misleading. None of these systems are to be regarded as more important than the others. Systems viability requires each one, and the information and communication links between each, to be present and functioning effectively.

10/9/91

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