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LOCAL RULES: SOME PROPOSITIONS FOR THEIR ESTABLISHMENT AND CONTINUATION

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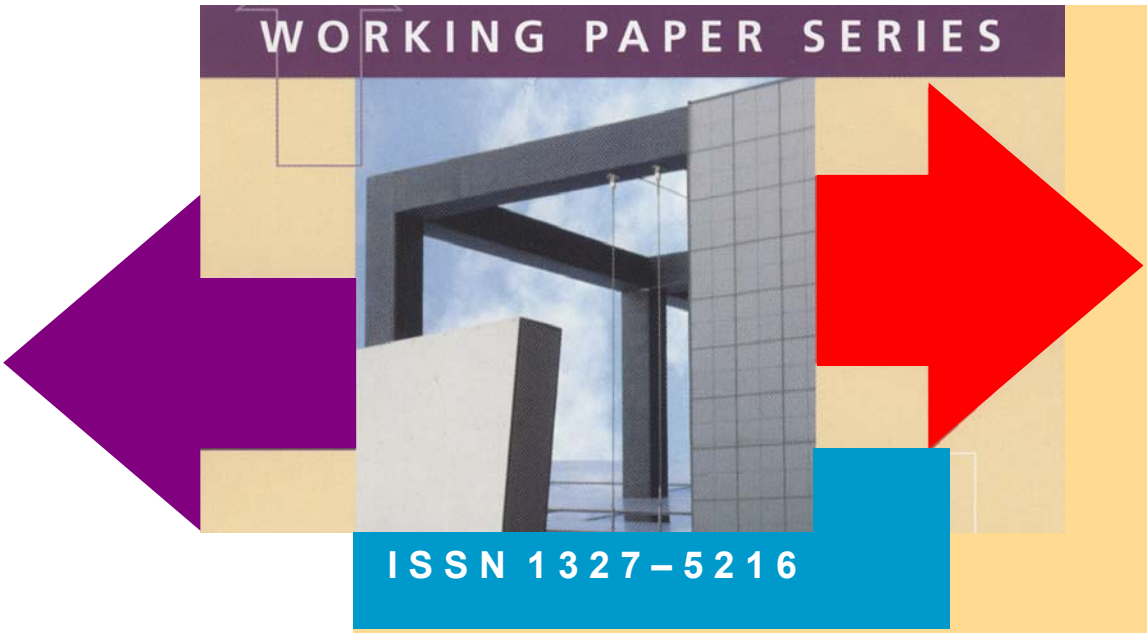

Abstract

This paper is based on findings from field research that identified local rules in organizations. It discusses these findings into a set of propositions that may explain the operational dynamics of local rules and the processes by which local rules survive or become extinct. The central metaphor for this discussion is that of the fitness landscape developed by Kauffman (1989) and Holland (1989). This metaphor provides a useful framework for understanding how stable and predictable patterns of behaviour develop in organizations. It is proposed that local rules have localities of action on fitness landscapes and that there is a set of conditions for their establishment and continuation based on the interactions across the locality boundaries. It is further proposed that there are conditions, characterised by co-adaptation, under which rules will survive in relatively stable forms and other conditions, characterised by competition, under which local rules change.

DEPARTMENT OF MANAGEMENT

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INTRODUCTION

This paper sets out to examine behaviour in organizations using the theory of local rule adaptation on fitness landscapes. Fitness landscapes and local rule adaptations by (Kauffman, 1995) provide a theoretical framework for understanding dynamic interaction in biological and social systems. A fitness landscape is the domain in which the fitness of any behaviour to survive is tested. Organizations comprise of sets of interconnected fitness landscapes on which organizational behaviour plays out. It is the testing of behaviour against fitness criteria that ultimately determines what actually happens in organizations. Local rule theory provides an integrative framework in which dimensions of the organizational landscape, such as leadership, morale or organizational structures, can be seen as determinants of the survival or extinction of behaviour.

Local rules have been seen as an organizing principle in the behaviour of wasps (Putters and Vonk, 1990), neural assemblies (Kerszberg, Dehaene, and Changeux, 1992), broad-band transport networks (Grover, 1997) In this paper it is suggested that local rule theory can be applied to organizational behaviour. In this context, organizational behaviour is seen as dynamic and competitive, where competitive means selective in relation to the behaviours of agents. Agent is a term frequently used in the self organization literature (Epstein and Axtell, 1996). Here however, "individual" will be used as a more appropriate term. Local rule theory also suggests that behaviour is emergent, that is, constantly changing in relation to the immediate environment. It further suggests that the emergent behaviours are the current "best fit" between the individuals and their immediate environmental demands. This behaviour emerges on an organizational landscape termed a fitness landscape. It is on fitness landscapes that adaptive behaviours create fitness peaks, where adaptive behaviours are most effective for the individuals that populate the landscape. The landscape is the organizational setting and the adaptive behaviours those behaviours that maximise payoffs to all individuals in the organization. It is important to recognize that while this applies to all individuals in an organization, the payoff for given individuals may not be the same.

Holland (1989) stated that many organizations were intrinsically dynamic, far from global optimum (always room for improvement), and continually self-organizing through the use of local rules that were the individual's attempts at adaptation to environmental demands. It is this continuous self-organization that maintains the organization in a state of dynamic equilibrium. Drawing on Holland (1989), it is argued that all behaviour is adaptation to some environmental imperative. It follows that such behaviour is also a response to an immediate, or local, set of conditions. The behaviours that emerge are termed "local rules".

Behaviour is an emergent property of the interaction between the local environment and the individual's survival instincts. However, survival has a broader definition than in the animal kingdom. Here survival behaviour is designed to optimize the chances of such "survival" imperatives as keeping one's job, earning more money, receiving a promotion, avoiding being injured or finishing work in time to pick up the kids. Each of these imperatives represents a peak that the individual must climb and these peaks are part of the landscape that individuals inhabit.

Related Work Serving to Validate this Research

Related work in the field of agent-based modeling provides cross validation of this approach. Much of this work demonstrated the application of specific functions, such as trust or co-operation, in the context of some organizational structure or policy. The specific functions are the equivalent of local adaptive rules and the organizational factors are the equivalent of landscape conditions. Moreover, such approaches allowed for an understanding of the complex, ongoing dynamics of organizations. Prietula and Carley (1999) suggested that organizational behavior could be viewed as "emergent behaviour from the collective interaction of intelligent agents over time" and called for "better operations of certain organizational phenomena" (1999, p. 41).

Sociologists would observe the interaction of local rules as "weak ties". Granovetter (2000) sought to link individual behavior to macro-sociological phenomena and commented that most network analysis dealt with "strong ties, thus confining their applicability to small, well defined groups" (2000, p. 41). He demonstrated that, by contrast, weak ties helped explain the interaction of small-scale dyadic ties. In sociological terms, local rule propagations would be the result of weak ties. Earlier, Granovetter (1973) commented "emphasis on weak ties lends itself to discussion of relations between groups and to analysis of segments of social structure not easily defined in terms of primary groups" (1973, p. 1360).

Kauffman (1989) used "fitness landscapes" to describe the space in which the rules or adaptive behaviours evolve. The evolutionary landscape is multi-dimensional with parameters that consist not only of the normal three dimensions of length, breadth and height, but also other dimensions that define the landscape such as climate, terrain, vegetation and density of species. In an organizational context, the landscape could be defined by dimensions as diverse as organizational structure, reporting relationships, Occupational Health and Safety legislation, rates of pay, and the physical layout of the organization. The dimensions of a landscape are invariant over lengthy periods of time. The contours of the landscape within these dimensions consist of peaks and valleys, which are, constantly evolving as the individuals in the landscape climb peaks or descend into valleys. Kauffman (1995) terms the peaks "fitness peaks" on which the payoff, or adaptive potential, for behaviour can be optimised. As an individual climbs such a peak, fitness conditions for other individuals on the landscape will change, both for better or worse, creating new peaks and valleys. Thus, while the dimensions of the landscape are relatively invariant, the contours of the landscape are a result of the interaction between the adaptive behaviours of the individuals on the landscape. The emergent behaviour on these landscapes is self-organizing around the imperatives of the local environment.

In such a system organization and order is an inevitable outcome of the dynamic interactions on the landscape. Kauffman, (1995:71) terms this "order for free". Here stable networks of successful local rule behaviours constitute the fundamental operating structure of an organization. It is this structure, defined by the fitness peaks of the landscape, which sets the limits for optimizing organizational performance. The extent to which local rule behaviour sets the limits on organizational performance is a central concern of research into local rule behaviour. (Haslett, Moss, Osborne, Ramm, 2000)

In a self-organizing system, it is useful to distinguish between individuals who are "landscape setters", those people who have the power to establish the dimensions of the landscape, from "landscape adaptors", those people who must adapt to such dimensions but whose adaptations set the contours of the landscape. The most effective role that management can take is that of landscape setter, setting the invariant dimensions of the landscape, rather than landscape adaptor, involved in the local interactions and adaptations. Organizational performance will be optimised by the extent to which the landscape dimensions are set by the organization considerations and sub-optimised by the extent to which the landscape dimensions are set by non-, or extra-, organizational considerations. Haslett et al (2000) demonstrated the impact of nationally set wage rates and conditions on local behaviour in mail sorting centres where work rates were varied to climb local fitness peaks created by national wage regulations.

Conventional wisdom would propose that performance is determined by organizational structure, set from the top, shaped by some grand design. Much of the organizational redesign of large corporations in recent years reflects this strong belief that top down re-organization will improve organizational performance. In contrast, local rule theory suggests that organization, in the forms that materially affect behaviour, occurs at a local level and is self-organizing.

The extent to which any consistent structured behaviour occurs across large sections of an organization will be entirely determined by the extent to which certain sets of behaviours are successful adaptive mechanisms in the specific ecological context. This paper suggests that local rules determine behaviour and that such behaviour is always sub-optimal, because of the complexity of the landscape dimensions. It also suggests that the extent of sub–optimization is defined by the operation of local rules. It is argued that understanding the ecological context of behaviour places organizational behaviour in framework that is on one hand dynamic and ever changing but on the other is characterised by long periods of stability. The following section outlines theoretical constructs for that understanding.

The Concept of Landscape, Locality and Locality

This paper proposes that local rules operate within localities and can be defined by the concepts of size, density, generative power (competitive-adaptive and co-operative-adaptive), and robustness. These concepts are described in the next section of the paper.

Locality size can be defined by the number of individuals who use the rule. A local rule that is used by only one person has a smaller locality than a second local rule that is used by a larger number of people. Most importantly, locality size will determine the persistence (or stability) of the rule. If one person is using the rule, that rule may be influential in terms of its interactions but its persistence will be related to that individual's tenure. A small locality may also have a very high level of interaction depending on the hierarchical position of the individual enacting the rule. Nonetheless, the life expectancy of such rules is limited to the enactor's tenure. Walker and Haslett (2000) reported the impact of a medical registrar's local rules on hospital admissions and the financial performance of the hospital. Here, the tenure of a registrar was usually six months and each new incumbent brought a new set of local rules, each set of rules generating different patterns of patient admissions.

Density of locality is the number of situations in which the rule is applied relative to the number of situations where it could be applied. A dense locality would have a high ratio of number situations in which the rule is applied to the number of situations in which it could be applied. The medical registrar's locality was small, (limited to one person) and dense because the rule was applied consistently.

The impact of local rules is described by their generative power, which is a measure of extent that a given local rule generates other local rules and adaptive behaviours in different localities. Generative power is therefore, also a measure of the extent to which a local rule changes the contours of the fitness landscape. Rules with low generative power are likely to be stable as they do not change the fitness landscape by generating new behaviours in individuals affected by the local rule. In this situation, competition and the threat of extinction to the rule is low, leading to stability and continuity in the local rule. In this situation there is limited interface and interaction between localities.

High generative power (and extensive interface and interaction between localities) produces two types of response: competitive-adaptive and co-operative-adaptive. In the case of competitive-adaptive generation, the local rule generated in one system will alter the fitness landscape of a second to the extent that a response will be required from the individual or individuals in the second locality (as shown in Figure 1). Here Local Rule A1 generates across the interface between the two localities resulting in adaptation in the form of a new rule, Local Rule B1.

Insert Figure 1 about here

In this example of generation, Local Rule A1 has generated Local Rule B1 in Locality B as a competitive response. Local rule A1 represents a competitive threat to Locality B and some response will emerge. The generation of Local Rule B1 is therefore termed competitive adaptive and Local Rule B1 is aimed at maximizing payoff, or the chances of survival, in the face of the competition from Local Rule A1. If the Local Rule B1 prove to be a successful adaptation, it will continue as a new local rule in Locality B. Haslett and Osborne (2000) observed local rules in a Kanban system. The managers local rule (Local Rule A1) involved changing ordering priorities for parts needed on an assembly line to avoid criticism from senior management. This change of priorities meant that assembly workers regularly ran out of parts. The assembly workers' local rule (Local Rule B1) was to take more parts than they needed and hide this buffer stock under their work bench.

Figure 2 shows the continued dynamic interaction across the interface between localities in competitive-adaptive generation. Local Rule B1's success extinguishes Local Rule A1 but also generates Local Rule A2 which is the competitive response to the success of Local Rule B1. Dooley (1997:85) described generation as a second order change of a schema "where there is purposeful change to better fit observations and

extinguishing as third-order change where a schema survives or dies". The process of competitive-adaptive generation represents the on-going dynamic involving the constant evolution of new local rules.

Insert Figure 2 about here

Haslett et al (2000) reported competitive adaptation in mail sorters in six geographically separated mail centres slowing their work rates to maximise payment through overtime or increasing them to minimise time at work (known as a "fly day"). The preference was for increased overtime but there were conditions where minimising work time was always the preferred option. This local rule could effectively add 50% to weekly pay rates. This was Local Rule A1. The management's response to "excessive" overtime payments was to employ more staff. This was Local Rule B1. This raised staff levels to a point where work loads were sufficiently light for every day to be a fly day, Local Rule B2, and sorters used their newly acquired free time to get a second job to make up for lost earnings in the mail centre.

Co-operative-adaptive generation is in contrast to competitive-adaptive generation. Here Local Rule A1 would enhance the fitness of Local Rule B1 by providing an opportunity for increased fitness rather than the threat of decreased fitness.

While competitive-adaptive generation can be seen as a negative feedback loop where the newly generated Local Rule B1 would seek to balance the impact of Local Rule A1, a co-operative-adaptive generation would, in contrast**,** be a positive feedback loop where each rule enhances the fitness of the other. This is shown in Figure 3 where the two local rules re-inforce each other's behaviour.

Insert Figure 3 about here

In the mail centre, supervisors took no active role in counteracting the slowing of work rates by sorters. This was because when sorters slowed their work rates to get overtime, supervisors automatically got overtime. It is worth noting that supervisors had no mechanism for creating overtime. Here the slowing of work rates and the supervisors turning a blind eye constitutes two re-inforcing local rules.

The concept of generation leads to the final definitional aspect of local rule theory: that of the robustness or fragility of local rules. Robustness and fragility refer to the likelihood of the continuation of the local rule. A local rule is robust when its generation is co-operative-adaptive and it creates a positive feedback loop that serves to stabilize the fitness landscape of other interacting, rules thus ensuring their continuation.

In contrast, a local rule is fragile when its generation is competitive-adaptive. Fragility is indicative of the behaviours being unlikely to persist. Here, because the rule is in a negative feedback loop, where it seeks to extinguish the impact of a rule in another locality. If a generated rule is successful, it will reduce the payoff to the original rule generator and this in turn will produce a new competitive response across the interface. Thus a rule is fragile in that its very success led to its extinction. Robustness and fragility are related to how long a local rule persists not to the payoff that is secured. Highly successful local rules can provide large payoffs but be fragile and hence short-lived.

In summary, the measure to be used for defining dimensions of local rules will be:

- The initial conditions for a fitness landscape on which the locality of a local rule will be defined by multiple dimensions. These will be relatively invariant over time. They will be interactive with propagating local rules.

- The measures of locality will be: size, the number of individuals using the rule, density, and the number of situations in which the rule is applied relative to the number of situations where it could be applied.

- The measures of generation across the interface of localities will be competitive adaptive and co-operative adaptive. Robustness and fragility describe the longevity of the rule based on the nature of generation.

There are three aspects of this work that need to continue. The first is building the data bank of examples. The second is to develop and test some quantitative measures of local rules and their localities. The third is to develop a deeper understanding about the nature of the interactions across locality interfaces.

The application of local rule theory to organizations provides an integrating framework for management theory. For example, the extent to which leadership, group membership or organizational structure (all common aspects of management theory) can be assessed by the extent to which they set the dimensions of local landscapes. It also provides a framework for understanding organizational life as a set of dynamic and emergent interactions in which some aspects of organizational life are stable and others not. Understanding management interventions as competitive adaptive local rules can provide insight into the reasons for the possible failure of such interventions. Understanding that management interventions need to be at the level of setting the dimensions for the fitness landscape can lead to increasing the chances of intervening successfully.

Most importantly, local rule theory suggests that behaviour is locally determined and that there is no grand management plan which co-ordinates and controls the life of an organization. Individuals work in a local environment where the pressures exerted by management may only be a small proportion of those to which they must respond. Local rule theory suggests to managers that their interventions in organizations must be at the level of landscape dimension and that even then their success will be limited because many of the dimensions of the landscapes of individuals are beyond management's control.

The extent to which we have come to believe organizations can be managed may well turn out to be a myth as we develop a deeper understanding of the role of local rules and self-organization in organizational life. Espejo, Schumann, Schwaniger and Bilello (1996) observe

> "Lower level primary activities create and do what people at higher structural levels could not discover and do by themselves, it is beyond their capacity. This is the meaning of autonomy at all levels. Each primary activity creates and responds to chunks of complexity of its own and strives for its own viability in the same way as the parent activity strives at a more global level" pg 110

This research on local rules demonstrates in detail how the striving for viability takes place. The challenge for management is make viability at the global level closely related to viability at the local and autonomous level. Carley, Kjaer-Hansen, Newel and Prietula (1992) found that in some agent-based models, increases in agents capabilities could degrade organizational performance.

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Figure 1: Rule generation across locality interface

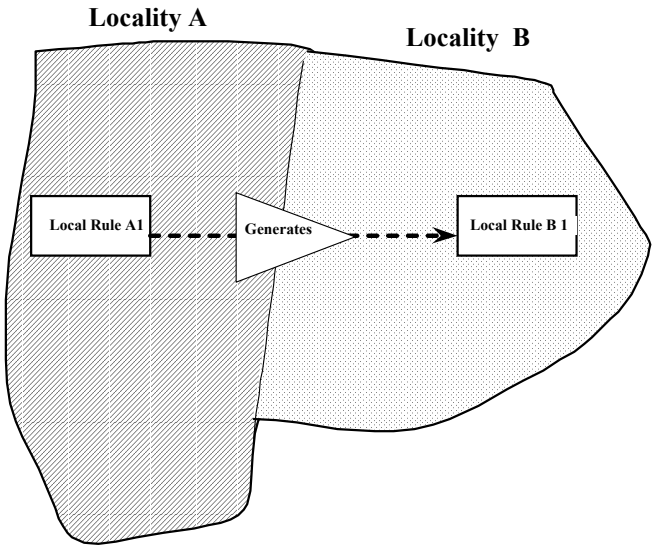

Figure 2: Competitive-adaptive rule generation across localities

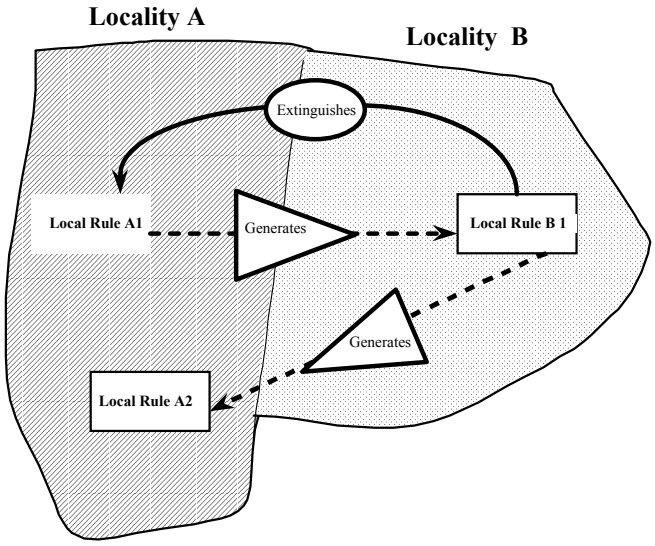

Figure 3: Co-operative adaptive rule generation across localities