# A Complex View of a Rural Transport System (Bwcabus)

Mr Owen Clark

Senior Research Fellow

University of South Wales

Mr Chris Lee (MBA, FHEA, CMILT, MIOM)

Senior Lecturer

University of South Wales

**Abstract**

*Since 2009, the Wales Transport Research Centre has enjoyed success with the Bwcabus project. Bwcabus has given rural communities around Newcastle Emlyn and Lampeter a fully accessible, on-demand, local bus service.*

*The aim of this paper is to reflect critically on the dominant theory of management discourse in the context of its traditional application to public transport systems. It challenges the view that the role of the 'professional management' within such a system attempts to gain control, certainty, and complete information in which to manage, consequently constraining such a system and hindering its adaptiveness, co-evolution and emergence.*

*This discussion reveals the theoretical position of Complexity (CAS) within a Human Active System such as Bwcabus. It also challenges the role of 'managerialism' on the micro-level planning of transport systems and draws upon the insights of a more emasculating and emancipatory theories of Complex Evolving Systems. This emerges a different set of strategic insights for Bwcabus including communication strategies, the perceived needs and motivation of passengers and the adaptive not paternalistic measures required. The conclusion drawn from this argument is that Bwcabus pragmatically acts within the naturally organic characteristics of the theoretical discourse known as complexity theory.*

*Key words: Complex Evolving Systems; Human Active Systems; Managerialism, Demand Responsive Transport System*

## 1. Introduction

The aim of this paper is to reflect critically on the dominant theory of management discourse in the context of its traditional application to public transport systems. It challenges the view that the role of the 'professional management' within such a system attempts to gain control, certainty, and complete information in which to manage, consequently constraining such a system and hindering its responsiveness, co-evolution and emergence.

This study will therefore attempt to explore the theoretical position of Complex Adaptive Systems (CAS) as an alternative discourse within a social or human active network / system of organisations, otherwise known here as a public transport system or Bwcabus. By viewing this type of system differently, it is to offer "another way seeing the world around Bwcabus". In addition, to provide some key strategic outcomes and insights intended as a strategic contribution from the study towards the enhancement of Bwcabus' sustainable development as a transport system.

### 1.1 What is Bwcabus?

Bwcabus is a demand responsive flexible local public transport service (DRT), helping people living in parts of rural Carmarthenshire and Ceredigion get to work and access

education, training and health services. DRT are services that provide transport on demand, scheduled to pick up and drop off passenger in accordance with their needs. It is therefore a 'hybrid', falling somewhere between that of a conventional timetabled bus service and a taxi. The Bwcabus service is tailored to the needs of the passengers by operating in response to pre-booked journey requests.

The first Bwcabus scheme became operational on 24th August 2009 located in North West Carmarthenshire and South Ceredigion, Wales. The Bwcabus DRT service is integrated with strategic public transport services, feeding passengers into these routes at a number of designated hubs. Innovative technologies have been incorporated into the system design to maximise the efficiency of the DRT services and ensure connections with buses on the strategic corridors. The introduction of Bwcabus has demonstrated that providing rural communities with an integrated rural public transport network can increase the frequency of public transport use and encourage a reduction in car use.

A fundamental issue underpinning this study is that Bwcabus already operates organically in its environment as an agent-driven system, so consequently one can posit Bwcabus naturally reflecting a complex evolving system (CES). This study therefore offers Bwcabus as an organisational entity an alternative insight into this phenomenon to underpin and sustain its future.

If we regard Bwcabus as an agent-driven public transport system, then behaviours and functions are inter-connected and interdependent between all of the agents involved within that system. As a result it is people that are the drivers of the system and who react to daily forces that can continually "punctuate equilibrium" (Romanelli, and Tushman, 1994), in such environments, causing them to co-evolve, transform and create particular sets of dynamics that could impact its operational effectiveness and efficiency.

Such dynamics exist in the "consciousness, thoughts, beliefs, subjective impressions and innate rationale knowledge" of each agent (Saunders et al, 2003) and consequently within the Bwcabus operating system. Within such a context, one could propose that these dynamics may be constructed by their 'instigators' as 'social phenomena' externally (from the macro-economic environment) or internally (within the Bwcabus organisations and processes). Social constructionism (Burr, 1995 and Berger and Luckmann, 1996) proposes that people like to share their interpretations of impacts occurring within their socially constructed environments and this arguably reflects in environments such as those operating around Bwcabus.

### 1.2 Proposed methodology and structure of the paper

It is proposed that the study's methodology is rooted in "social constructionism" (Berger and Luckmann, 1966), because all knowledge, including our most basic taken-for-granted assumptions of everyday reality for Bwcabus as a responsive transport system, is derived from and maintained by its social interactions. When people interact within this system, they do so with the understanding that their respective perceptions of reality for a responsive public transport service are related, and as they act upon this understanding their common knowledge of reality becomes reinforced, (Gadamer, 1960, 1989 & 2008), (Bourdieu, 1986 & 1991) and (Saunders et al, 2003).

Consequently the methodological underpinning will be phenomenological in nature (Saunders, 2003 and Collis and Hussey, 2003), as it attempts to understand and interpret human behaviour in a public transport. It is proposed that the research strategy will be subjective and built through induction in an attempt to understand how humans interpret and socially construct their worlds within a business environment such as Bwcabus and by investigating and presenting this reality as a complex evolving system.

From such an approach a set of suitable strategic outcomes and insights can be determined and interpreted for Bwcabus to consider for the future sustainable development of the organisation. The structure of the main body of the paper will therefore be in three main parts: -

The first part will define complexity theory (CAS) and offer a theoretical position for this discourse. Here there will also be some clarification surrounding the meaning of the term "complexity", as this can often be misunderstood. Defining will also include the presentation of a conceptual framework to underpin the pragmatic attributes of Bwcabus operating as a CAS and this will be provided through the "Ten Generic Principles and Characteristics of Complexity", (Mitleton-Kelly, 2003).

Following on logically, the second section will provide "examples of Bwcabus' adaptive characteristics", which simply presents how key attributes of Bwcabus, naturally relates to CAS as a systems approach to explain how Bwcabus operates.

The third and final part of the paper will draw suitable conclusions and focus upon suitable insights and outcomes for Bwcabus to consider as strategic options for the future sustainable and adaptive development of the organisation.

## 2. Defining Complexity Theory (CAS/CES)

### *2.1 Defining Complexity*

In order to present a suitable context for the meaning of complexity for this study, a "complex adaptive / evolving system", is a system that is capable of thriving at the edge of chaos (Pascale, 2005). Such a system can be is defined as - "a system of individual agents, who have the freedom to act in ways that are not always totally predictable, and whose actions are interconnected such that one agent's actions changes the context for other agents," (Mitleton-Kelly, 2003; Stacey, 2000).

Chaos theory is a key constituent part of complexity thinking, but chaos it is not the same as complexity as it is sometimes misconceived? Chaos theory is based upon non-linear dynamics or rules of interaction and these rules are founded on iteration that gives rise to extraordinary intricate behaviour such as levels of turbulence. This turbulence emerges disorder which manifest from "rules or regularities" in the environment, (Mitleton-Kelly, 2003), which can be repeated time and time again and eventually result in coherent order. Simply, chaos theory then according Wilding, (1998) and Mitleton-Kelly, (2003), is the disorder that emerges when the steady-state in any system, organisation or entity has been punctuated. Turbulence and disorder arguably punctuate the Bwcabus system daily, creating agent driven chaotic and dynamic change for the management team to address.

"Complexity is therefore the order that emerges out of the disorder of chaos", (Mitleton-Kelly, 2003) and capable of adapting and evolving to the 'rules of interaction' – it's the end and not the means! Complexity is a nonlinear, interactive system which has the ability to adapt to a changing environment and such systems are characterised by the potential for self-organisation, existing in a non-equilibrium environment. These are all dynamics that face Bwcabus as a transport system every day.

"Complex Adaptive Systems (CAS)" or sometimes known as "Complex Evolving Systems" (CES). They are self-similar expressions and often used synonymously in the literature concerning complexity theory. For the purpose of this study and Bwcabus, complexity will be referred to as CAS.

CAS is systems that self-organise and can transform their internal environments through natural selection. A key issue of complexity is "the emergence of new order". Some of the key features of Complex Adaptive Systems (CAS)" which can be explored through Bwcabus, are according to Mitleton-Kelly (2003), Pascale, (2005), Higgins (2006): -

- The identify regularities in the information;
- A complex system is one in which the exact patterns are not repeatable;
- Complex behaviour of a system emerges from the interaction of the diversity of individuals or agents and the relationships between those agents within the system itself;
- In complex systems, the system responds to external stimuli (e.g. demand for transport) and adapts its behaviour and learns;

- In complexity, semi-autonomous agents interact evolving to maximise functionality;
- A complex system can never be in a state of equilibrium because elements are always unfolding and are in transition, out of which and through the simple interactions of (passengers as) agents, a complex adaptive system generates emergent, creative behaviour;

### *2.2 Clarifying some of the misconceptions surrounding the notion of complexity theory*

It is at this point that it is worth emphasising how the notion of "complexity" can often be misunderstood and interpreted and this confuses the real meaning of this paradigm when attempting to be applied as outlined above.

In very simple terms, complexity is often interpreted to mean 'difficult or complicated' (The Concise Oxford Dictionary). Referring to some supply chain commentators e.g. Forrester,(1958); Wilding, (1998); Harland and Lamming, (2001); Macbeth, (2002); Sahay, (2003) Harland et al (2003); (Childerhouse and Towill, (2004); Christopher and Lee, (2004); Peck, (2005), all explicitly and implicitly use terms associated to complexity in their work around the supply chain dynamics. Sometimes CAS issues can be submerged within these dynamics such as within demand magnification, risk, trust, supply networks and vulnerability, etc, but interpretation could infer that typically complexity" means supply chain networks that are 'difficult or complicated to manage'.

Although some overlap might exist with CAS in parts here, overall these definitions seem to contrast with the principles of CAS, which intends the use of chaos as an entropic state, from which complexity or new order emerges through adaption from individual's behaviour within a system. This perspective therefore views a system such as a a public transport system in this study for example predominately as "a human activity system", (Burns, 1998; Mitleton-Kelly, 2003; Stacey, 2003; Cilliers, 2005;. Pascale, 2005).

### *2.3 Presenting CAS as a conceptual framework*

Figure 1 below outlines the "Ten Generic Principles and Characteristics of Complexity" (Mitleton-Kelly, 2003): -

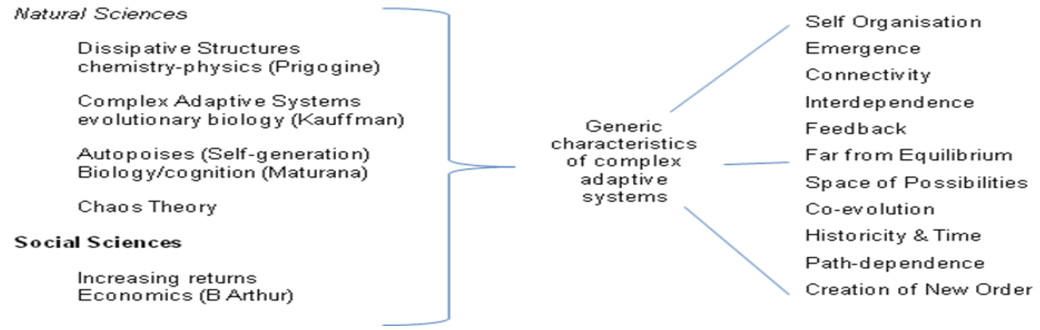


*Figure 1 - "The Ten Generic Principles and Characteristics of Complexity" (Mitleton-Kelly, 2003):*

The attributes contained on the right hand-side of figure 1 are the ten principles of complexity (CAS) that will form part the theoretical framework that could underpin an investigation into how these characteristics might manifest themselves in a responsive public transport system such as Bwcabus.

The attributes outlined on the left of figure 1 are contextual and illustrate the origins of CAS, which appear to root and justify CAS appropriately in the type of ontological and epistemological assumptions indicated above, most especially in parts of the natural sciences, e.g. through "autopoiesis or self generation" (Varela, 1995) and also, within the social sciences, such as anthropology, most especially social anthropology i.e. the study of humanity, sociology as well as economics.

### 2.4 The theoretical position of CES with regards Bwcabus as a 'demand responsive transport system'

As a context to the proposed practical contributions of CAS to Bwcabus as an organic public transport system, observations suggest that in traditional transport systems agents or stakeholders impact in terms of levels of "interest" & power". For example, professional managers, bodies and Governments typically attempt to rationalise the demand and dynamics surrounding public transport requirements with tendencies to 'dampen-them' (Pascale, 2005) applying control objectives and systems such as, governance structures (e.g. rules and regulations, etc); legislation, professional codes of conduct and other ethical frameworks, which typically develop performance measures. In the traditional classical system, these arguably might often become counter-intuitive and create 'mock-bureaucracies' (Gouldner, 1954) or the transport system to operate within – e.g. rigid timetabling. This could create barriers to innovation and creative if these become entrenched in the same and unmoveable.

CAS will acknowledge this traditional discourse to some extent, but with a far more flexible lens. It observes objectives as "a boundaries" (Kauffman, 1993) to facilitate empowerment for adaption and new order. The natural and social sciences refer to this as autopoiesis or self-generated systems (Varela, 1995). In the logistics and supply lexicon, Gattorna (2009) for example refers to this as "living systems" where there is a provision for the notion of "living supply chains" and other related systems such as transport – i.e. "the dynamic supply chain alignment", (Gattorna, 2009).

The traditional and dominant discourse tend arguably to be ones that hold typically rational-economic perspectives. It is contended by CAS thinkers, most notably Mitleton-Kelly, et al (1998 & 2003), but also (Pascale, 2000); (Stacey, Douglas, Griffiths and Shaw, 2000); (Stacey, 2001 & 2005), (Forsenca, 2002); (Cilliers, 2005), that a managed and rational-economic view of systems such as traditional transport systems, where the role of the 'professional supply chain manager' attempts to gain control, certainty, and complete information within that system and it is that vision that could constrain human activity, could easily become counter-intuitive, preventing those transport systems from adapting, co-evolving and emerging new order that sustains and develops that system for the future.

Pascale (2005) offers a "new life cycle view" of things through the lens of CAS. Pascale further suggests that in the more classically-scientifically oriented business perspective, where the machine-view or mechanistic of the world prevails, systems operate in a model that "Takes, Makes and then Breaks".

In such an additional operation, Pascale (2005) again proposes that lower levels of sustainability exists, because at the end of the process, "both breaking environmental and social balance through high-impact and production techniques, which fosters a spiral of obsolescence in which products and systems are used, but then discarded." This idea can be applied to traditional-run transport systems.

Pascale supported by Stacey (2005) then offers that a CAS approach can operate differently in an "Innovate, Proliferate and then Aggregate" way." It is then suggested that in this 'model' that - "nature favours adaption and fleet-footedness in entities and systems and that all systems compete when they must, but organisations strive, when possible, to reproduce more rapidly than their rivals and to dominate by sheer strength of numbers" – i.e. the aggregation or as economists refer to it as "increasing returns" (Arthur, 1995), supported by rapid expansion or proliferation.

CAS is therefore a direct challenge of the customarily inherent principles of management where systems, including transport systems tend to be controlled through the traditional dominant discourses of classical management (Fayol, 1949), i.e. planning and organising, commanding, co-ordinating and controlling and in addition, the verification element of Fayol's work, evolved within the thinking of (Taylor (1912), through the emergence of measurement within the scientific management era. In the latter the assumptions are that systems and process must be measured and controlled through 'science' and that managers can scientifically select each worker for a job or role in that process and, then match the science'

of the job with the 'scientifically selected worker' and moreover, according to that management and workers must co-operate.

Consequently the exponents of classical and scientific management (Taylor, 1912; Fayol, 1949; Urwick, 1952; Brech, 1975) and even in bureaucracy through the sociologist Weber (1947) have always been principally concerned with linear and mechanistic systems and structures for organisations. Hence, transport systems have arguably been traditionally viewed and treated as a rational-economic system. It is these deep-seated principles that arguably still prevail in the paradigms and practices of many managers in the 21 Century and also still within the prominence of academic concepts and principles too? These are key assumption that this study sets-out to challenge by presenting Bwcabus as a responsive and natural transport system operating organically within the characteristics of complexity.

As Remenyi et al (1998) indicates that "the strongest argument the interpretive could mount is the necessity to discover.....the details of the situation (i.e. whether a CAS or rational-economic one) to understand the reality or perhaps a reality working behind them". Here we could recognise that both CAS and rationale economic perspectives of management could live together in the specialist field of SCM, whether it's always fully appreciated or not?

Within the 'traditional currency' of management thinking, CAS is probably nearer to human relations and social psychological approaches to management, originated through Elton Mayo's work (i.e. in the Hawthorne Studies, 1927–1932), which places people as the focus of any system or organisation as well as research. These principles could be used to underpin a similar approach to the system known as a supply chain. Adopting such a premise could become the origins for perceiving transport systems as always operating as a 'human active system', where people as agents (Kauffman, 1993, 1995 & 2000), are a primary role within an adaptive sub-system (Katz and Khan, 1966) of organisations, otherwise known as internal and external supply chains.

As a result, we could view the supply chain as Gattorna (2009) does, as an organic rather than mechanistic system as figure 2 below "an evolution of strategic management" attempts to indicate. It is possible that any system will be integrated with levels of connectivity, or, differentiated by creating new order, far from the original steady state or equilibrium.

CAS views connectivity through biological ecosystems traits as Bwcabus could arguably also represent, because as Mitleton-Kelly (2003) proposes ".....that in human ecosystems the same is true.....[and that] there are networks of relationships with different degrees of connectedness". Mitleton-Kelly expands this by suggesting that the "greater interdependence between related systems or entities as the wider ripples of perturbation", as arguably we might find responsive transport systems such as Bwcabus?

This idea is also reflected in the "contingency management approach" to systems thinking (Burns and Stalker, 1961; Leavitts, 1965; ,Lawrence and Lorsch, 1967; Checkland, 1981), all of who indicate that the main traits of integration and differentiation emerge through the attitudes and behaviours of humans acting as managers and other stakeholders or agents and operating within human adaptive systems.

Such a contingent approach applied to transport systems would view people e.g. passengers, but most especially the management team at Bwcabus, more for their values and leadership, and the use of inherent skills and talents to emerge innovative and creative new order through accepted levels of risks within the boundaries of the system operated. A CAS perspective would become the enabler(s) to empower and entrust Bwcabus staff to operate more responsively and with high levels of 'adaptiveness' from higher levels of communication and connectivity with the needs and motivation of its market to use this type of transport system. In summary, a human active approach would seek innovative solutions within the boundaries of a more democratic and collegiate (Adair, 1973) transport environment, rather than the traditional authoritative-exploitative / benevolent- exploitative management style which is often just task-orientated.


*Figure 2 – An Evolution of Strategic Management*

In order to view transport systems methodologically i.e. how Bwcabus was designed to operate and match this to the lens of CAS, the notion of a socially constructed supply chain would need to exist, where the focus would be upon social groupings. This would involve a closer understanding of the types of passengers that demand this type of public service now and in the future and also, how they might connect their perceptions of that need and motivation within their environment which is currently rural centric to sustain the operation of an effective and efficient socially constructed transport system, (Berger and Luckmann, 1966; Gadamer, 1960. 1989 & 2008); Derrida, (nk); and Bourdieu, 1991).

In addition there will be a need to revisit the "system dynamics" inherent in all supply chain type systems, which transport systems might also reflect as 'human supply chains'? To begin with, Forrester (1958) and how human behaviour through poor levels of transparency concerning caused by human behaviour driven by for example, market capacity involving transport demand vis-à-vis availability for the passenger, could contribute to levels transport / supply chain magnification, i.e. Bwcabus force-fitting timetables……..

This highlights how other supply-side dynamics and their instigators, such as uncertainty of supply and demand from both Bwcabus and its market (Childerhouse and Towill, 2004), deterministic chaos (Wilding, 1989) created from magnification and uncertainty and driven by the potential ineffectiveness of the 'rules of the current system' and parallel interactions or connectivity as demand is in reality non-linear, which amplifies the levels of risk in the system for Bwcabus (Peck and Juttner, 2002; Harland, Brenchley and Walker, 2003). The bottom line is that system magnification, uncertainty, risk and trust, are all dynamics currently inherent in the Bwcabus transport system which are all primarily 'man-made'(Sahay, 2003).

A greater understanding of the causality suggested above could emerge adaption and new order for Bwcabus where effects could be researched further through the applied CAS principles and characteristics, e.g. as in those in figure 1 above. There appears at this stage to be a direct link between these dynamics, Bwcabus as a public transport system and the underlying theories of CAS?

Why? CAS appears to suggest that values differ through a natural system. CAS promotes leadership more than management and that the leader needs to define the boundaries within a social ecosystem such as Bwcabus (Lewis and Regine, 1999). Risk and trust are evident in the agent systems which are cultivated by leadership empowerment and, the ability to take risks to survive (Kauffman, 1993). Consequently, a natural system will then foster connectivity creativity and innovation in a soft system methodology, again through empowerment and integration in the system

A "soft systems methodology" lends itself to so-called "messy problems or issues" such as those encountered in the Bwcabus system, because this type of transport system needs to embrace as Wilding (1998) refers – "problems which involve psychological, social, and cultural elements, such as "deterministic chaos", "parallel interactions" and "amplification", some of the key system dynamics also facing the Bwcabus Operation currently.

### 3. Examples of Bwcabus 'adaptive characteristics'

This section will simply critique the practical operating characteristics of Bwcabus utilising some of the "Ten Generic Principles and Characteristics of Complexity", (Mitleton-Kelly, 2003) to conceptualise these. This section will illustrate how Bwcabus operates organically in its environment and as stakeholder behaviour is consistently influential in that operation, it consequently operates naturally as a complexity evolving system.

*Table 1 - Examples Of The 'Adaptive Characteristics' of Bwcabus*

| **Self-Organisation** | **Emergence** | **Connectivity** | **Feedback** |
|---|---|---|---|
| *"The spontaneous emergence of order, the occurrence of self-organisation"* | *Emergent properties, qualities or structures, arise from the interaction of individual elements or properties* | *A decision or action by an individual (e.g. group, organisation, institution, supply chain or any human active system) may affect related individuals or systems.* | *Positive and negative feedback mechanisms are reinforcing, amplifying and balancing for an entity, organisation and a system* |
| The introduction of Bwcabus was a radical change. Passengers now have more control, rather than being constrained by a bus timetable they have more flexibility to travel when and where they wish.<br><br>Between 07:00 – 19:00 Monday to Saturday, Bwcabus operates as a demand responsive bus service. This requires that the schedule is made up of pre booked journeys made by individuals or groups. Thus the schedule will change from day to day to accommodate the needs of the passengers, avoiding the problem of providing a bus that nobody uses.<br><br>Bwcabus users are required to register to use the service, this is a requirement of the rules for flexible transport services as set out by the traffic commissioner. Take up is mixed across the zone. This demonstrates the self selecting nature of registration depending on socio economic factors such as car ownership, age, gender etc. | Although the daily Bwcabus schedules are determined by passengers needs and booking requests, over time regular patterns and structures emerge. These become formalised in block bookings, where the user makes a month's worth of bookings or with the introduction of fixed route services.<br><br>An example of this is the emergence of the fixed route 611 service from Rhydlewis. Prior to Bwcabus this area had a once weekly bus service. Upon the introduction of Bwcabus passengers began to make bookings most days of the week. Demand for this service grew and now there is a fixed timetable service on Mondays, Thursday and Fridays, with a smaller number of users (not enough to justify making it a fixed journey) also regularly travelling on Tuesdays and Saturdays. | Bookings are taken on a first come first served basis. Thus the decision of one passenger to make a booking will impact upon other passengers ability to make bookings at or around that same time. Passengers who book further in advance therefore have the advantage of more frequently getting a journey at the time they desire, while passengers who book close to the booking deadline find their journey options limited by the bookings already in place and the limited availability of the buses.<br><br>There is also a high degree of interdependence between Bwcabus and the other public transport services. For example, if the Bwcabus is connecting from another bus service, and that service is delayed, then Bwcabus may have to wait for the connecting service to arrive. The Bwcabus driver may then have to alter the order of his next pick ups to ensure the passenger is not left stranded. | Customer feedback is very important to ensure that the system continues to respond to passengers needs. Customer feedback on routes, procedures, requirements are collected through on bus surveys, interviews and speaking to the passengers who use the service. Registered members who don't use the service are also surveyed to identify barriers that prevent them using the service.<br><br>One example of feedback influencing the system, is where there is no identified bus stop for the passenger to use. In this case the pick up point would be designated as their home address or a 'ghost stop' maybe created by the manual scheduler to allow this user to access the service. This means that for a rural area the services are far more accessible than would normally be the case. |

*Table 1 - Continued*

| Far From Equilibrium | Exploring the Space of Possibilities | Co-evolution | Historicity & Time |
|---|---|---|---|
| *In far-from-equilibrium conditions, non-linear relationships prevail, that cause a system to reorganise itself and create some new order and organisation* | *To survive an entity, organisation or system, needs to explore its space of possibilities and generate variety (away from the equilibrium state)* | *The way in which each element influences and is in turn influenced by all other related elements in an ecosystem is part of the process called co-evolution.* | *The series of critical decisions each individual takes from several possible alternatives that may determine a particular life path for that individual* |
| The competing needs of passengers means the schedule can never be 'stable' therefore the booking system has to respond dynamically.<br><br>The passengers are by enlarge self organising, the timetable is under their control based on the bookings that other passengers have made. Thus the schedules never remain static, as passengers competing needs for the buses determine who uses the bus, where it travels to and from and at what time. Thus the Bwcabus system has to be able to deal with this dynamic environment, determining bus availability and identifying opportunities to join 'similar' journeys to improve the schedule efficiency. | Within the services boundaries (i.e. operating area, number of buses, Traffic commissioner rules) the passengers self organise. The service operates 12 hours a day, 6 days a week. Within this time passengers are able to make bookings as required, depending on bus availability determined by other passengers bookings. The booking system will recognise opportunities to link passenger journeys together or combine into a single trip.<br><br>It is therefore quite surprising to identify that a large number of passengers are very rigid in the times they travel. Many will continue to request trips at exactly the same time as the old fixed timetable service that Bwcabus replaced. This shows a level of conditioned behaviour, that despite the endless possibilities that Bwcabus offers, where passengers travel at the same time out of habit. | There are a number of drivers of change exerting an influence on Bwcabus. These include socio economic drivers, political influence at national, regional, and local levels, technological, environmental, and legislative drivers.<br><br>These influence the Bwcabus ecosystem in a number of ways, resulting in changes in management, needs and motivations of the users, perceptions of users, stakeholders and wider public and changes in communication strategy.<br><br>These drivers mean the Bwcabus system is ever evolving in response to change and thus is constantly evolving a new order. | The service is improved by regularly reviewing and learning from experiences. This includes monthly operational meetings involving all service providers. Performance is reviewed at these meetings and actions agreed to address any identified issues, including addressing any passenger complaints and other feedback. |

## 4. Conclusions - Practical strategic outcomes and insights for Bwcabus to consider

The aim of this paper was to reflect critically on the dominant theory of management discourse in the context of its traditional application to public transport systems. It challenged the view that the role of the 'professional management' within such a system attempts to gain control, certainty, and complete information in which to manage, consequently constrained such a system and hindered its potential responsiveness or adaptiveness, co-evolution and emergence.

This study explored the theoretical position of Complex Adaptive Systems (CAS) as an alternative discourse within the social or human active network / system of organisations, otherwise known here as Bwcabus as the public transport system used as the focus of this study. It illustrated that Bwcabus operates organically in its environment and as it is an agent-driven system which consistently influences that operation, it consequently operates naturally as a complexity evolving system.

As an outcome of the paper a set of four main strategic insights can be concluded, which emerges a set of four related outcomes for the Bwcabus organisation.

### 4.1The strategic insights

Improved perception of the Bwcabus organisation from key stakeholders – i.e. Bwcabus current and other potential markets;

- CAS provides less 'noise' in the system as emergence from the key stakeholders predominates;
- Improved communication channels between the Bwcabus organisation and its key stakeholders as indicated in Table 2 above;
- Consequently the need and motivation to use Bwcabus by its market and potential markets improves;
- Leadership and not management emerge from within the Bwcabus system, once there is a realisation that stakeholders cannot always be controlled and that the setting of boundaries & not controlling objectives emerges the new order.
- A balance is struck between the traditional 'harder' classically and scientific outcomes and more 'softer' emergent and people orientated features, coupled with an improved ability to deal with dynamic change.

### *4.2 Strategic outcomes*

***Values:*** The Bwcabus organisation values will differ if the notion of a public transport system is viewed through the lens of a natural complexity system across the business and between management, employees and its markets. Business needs through increased synergy in perception of the business and its value to the current and future passengers and improved communications, resulting potentially in increased market motivation to use Bwcabus, offering considerable levels of sustainable development for the organisation.

***Leadership*** (and not management): Democratic leadership is evident in a natural system, but not enabled due to management involvement. Management at Bwcabus need to set adaptive boundaries and not fixed objectives allowing greater flexibility and responsiveness. This will emerge the need for a different perspective regarding 'risk and trust'.

***Risk and Trust***: Trust is evident in the agent –system such as CES and indeed high levels of trust currently exist within the Bwcabus organisation. However, this needs to be further cultivated by Bwcabus by management 'letting-go' within boundaries set and by embracing higher levels of self-organisation. This will require a critical reflection over how risk is currently perceived and mitigated at the Bwcabus organisation .

***Creativity & Innovation***: The natural complex system thrives on creativity and innovation – "yesterday's timetable is history today" and although there is a reasonable level of realisation

surrounding this point, by allowing greater trust and risk taking this should also foster higher levels of creativity and innovation too, through employee and management interaction within the Bwcabus system and improved organisational market knowledge from better perception of the organisation and improved communication channels, the need and motivation to use Bwcabus will also improve.

The Bwcabus organisation needs to embrace and champion these key CAS outcomes and insights and consider itself more as a 'natural system' as it evolves daily for increased adaptability and responsiveness to a constantly changing and dynamic business environment. Through an increased realisation that Bwcabus is a natural and complex system, then the sustainable development of the organisation will also increase.

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