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THE CO-EVOLUTIONARY DYNAMICS OF IS ENGAGEMENT

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Abstract

In this paper we consider the co-evolutionary dynamics of IS engagement where episodic change of implementation increasingly occurs within the context of linkages and interdependencies between systems and processes within and across organisations. Although there are many theories that interpret the various motors of change be it lifecycle, teleological, dialectic or evolutionary, our paper attempts to move towards a unifying view of change by studying co-evolutionary dynamics from a complex systems perspective. To understand how systems and organisations co-evolve in practice and how order emerges, or fails to emerge, we adopt complex adaptive systems theory to incorporate evolutionary and teleological motors, and actor-network theory to incorporate dialectic motors. We illustrate this through the analysis of the implementation of a novel academic scheduling system at a large research-intensive Australian university.

Keywords: co-evolution, information systems, complex adaptive systems, actor-network theory.
1 INTRODUCTION

The phenomenon of IS and organisational change, in particular the theorising of its process and causality, has troubled IS researchers and practitioners since the field’s inception. The issue of change is particularly pertinent as the central object under study is a changing entity within its environment (Avgerou 2001). It is somewhat curious then that as organisations attempt to become more flexible and adaptable they focus upon streamlining organisational processes through systems integration. A consequence of such integration, however, is the removal of protective cocoons (Kallinikos 2005) that insulate systems from exogenous change thereby exposing actors to adaptive turbulence. This interconnectedness “challenges the old wisdom of control accomplished through the separation or loose coupling of social, organizational or technological processes” (Kallinikos 2005) setting in train an unforeseen, emergent dynamic of restlessness across systems and processes. How then should we theorise such a dynamic?

Theoretical model of change have been categorised meta-theoretically according to motors (Van de Ven & Poole 1995), or form (Weick & Quinn 1999). Van de Ven and Poole (1995) present a typology of change models based upon four ideal type motors of change: life cycle, teleology, dialectics, and evolution. They present this typology across two axes: the unit and mode of change. The unit of change classifies models by whether they consider either a single entity (lifecycle and teleology), or multiple entities (evolution and dialectic). The mode of change considers whether the models are prescribed (evolution and lifecycle), or constructive and emergent (dialectic and teleology). These ideal type motors need not operate exclusively, but rather can be combined to explain complex organisational dynamics and to “remedy the incompleteness of any single model of change” (p.527). Weick and Quinn (1999), on the other hand, consider the form of change as being episodic or continuous. Episodic change, such as Lewin’s (1951) three stage unfreeze, change, refreeze, or Tushman and Romanelli’s (1985) punctuated equilibrium, describes organizational change that tends to be infrequent, discontinuous, and intentional (Weick et al. 1999). Continuous change, on the other hand, emphasises the emergent nature of change (Orlikowski 1996) that is ongoing, and evolving. It regards organisations as emergent and self-organising, and change as being “driven by organisational instability and alert reactions to daily contingencies” (Weick et al. 1999).

Rather than fragment the observable IS engagement phenomena according to these meta-theoretical classifications, this paper will instead consider the co-evolutionary dynamic where episodic change of implementation occurs within the context of linkages and interdependencies between systems and processes. We regard engagement as a co-evolutionary process where the software system, the vendor, the organisation and its individuals adapt continually to the changing context wrought by the movements of one another. Since theories of organisational change and development can be built from one or more of the ideal type motors (Van de Ven et al. 1995), we propose to understand how systems and organisations co-evolve in practice by adopting a tri-motor model using complex adaptive systems theory to incorporate evolutionary and teleological motors, and actor-network theory to incorporate dialectic motors thereby representing an unexplored logical combination of motors (Van de Ven et al. 1995, p. 533). By studying co-evolutionary dynamics from a complex systems perspective we hope to move towards a unifying view of IS and organisational change.

2 THEORETICAL BACKGROUND

2.1 Complex Adaptive Systems – an evolutionary and teleological perspective of change

An important starting point emphasised by complexity theorists is to counterpoint ‘complexity’ against ‘complicated’. Complicated systems, although composed of many intricate parts, can be understood as the sum of these parts. Complex systems on the other hand are comprised of populations of
interacting entities where the overall system behaviour is not predefined but rather emerges through the interactions of its entities. Complex adaptive systems (CAS) theory is a branch of complexity research that focuses upon the dynamics of complex systems by unpacking the adaptive behaviour of interacting actors, and is therefore regarded as offering great potential to inform organisational research (Morel & Ramanujam 1999). Axelrod & Cohen (2000) define a CAS as a system composed of a population of agents, that we will refer to as actors, that seek to adapt. These actors can equally be actors that act, or artefacts and tools that can be manipulated (Kaplan & Seebeck 2001). Actors, or populations of actors, interact with their environment and other actors within neighbourhoods, and employ a variety of context bound strategies that may be planned and purposeful or conditioned and reactive. Within the system a variety of performance measures exist to reinforce actors or strategies. These reinforcement mechanisms play an important role in steering the behaviour of actors; the design and application of criteria for success, coupled with the attribution of credit, creates an environment in which actors may choose to act in a manner that protects or maximises their perceived interests. Reinforcement mechanisms, whether conceptualised as social rule systems (Geels 2004) or interests maps (Callon & Law 1982), do not operate within a static objective reality, but rather are interpreted to create an intersubjective-objective reality that is “reflexively related to actor’s conceptions of their own interests” (Callon et al. 1982). Figure 1 demonstrates the interplay between social rule systems, actors, and their actions. Notably there are two feedback loops; social learning, and actor structuring. Social learning represents sociological and institutional dynamics typically operating over longer periods (years, decades), whereas actor structuring represents interactions between actors, their positions and relationships, typically operating over shorter periods (months, years) (Geels 2004).

Figure 1. Actor-rule system dynamics (Geels, 2004, adapted from Burns & Flam 1987)

Within such a framework, CAS theorists seek to understand how actors and/or strategies change over time creating variation, and how they become more or less common within a population (selection). Co-evolution occurs when actors are forced to adapt continually to the changing context wrought by others’ strategies in order to remain relatively fit (van Valen 1973). Unlike traditional evolutionary models that purely describe forces in terms of their impact upon a population (Van de Ven et al. 1995), CAS is also concerned with the intentionality and enactment of individual actors thereby incorporating elements of teleological motors of change. When considering teleological motors and intentionality, rationalist/functionalist approaches typically view Management as an “active” organisational brain that controls a “passive” organisational body, namely the human and non-human actors within the organisation, with the implicit assumption that managerial action is fundamentally adaptive and
beneficial (Kaghan & Bowker 2001). Indeed much managerial-induced episodic change, such as IS engagement, is driven from this perspective of enacting an envisioned end state. Intentionality, however, is not the sole domain of managers, and given that rights and resources are typically unequally conferred, and that actors may be subject to different reinforcement mechanisms the framework leaves room for conflict and power struggles (Geels 2004). Therefore whilst CAS provides a useful lens to understand the motor of co-evolution (Kim & Kaplan 2006), our understanding of the co-evolutionary dynamics is strengthened by incorporating a dialectic perspective such as actor-network theory to understand how order emerges in practice.

2.2 Actor-network theory – a dialectic perspective of change

Actor-network theory (ANT) focuses upon the negotiations and trials of strength that are necessary to achieve partial blackboxing of new technologies and processes (Latour 1987, Law 1992, Walsham 1997). It relies on the concept of socio-technical systems as a negotiated order constructed, tested and reproduced through action (Kaghan et al. 2001), focusing on how it is that durability is achieved (Law 1992). ANT theorists stress that closure of blackboxes is neither complete nor final (Latour 1996) and require continued work to hold the divergent interests of allies in place thus demonstrating an interesting dimension of ‘order’. Rather than merely being defined as a state or a pole, we see that order is an effect generated by heterogeneous means (Law 1992) and that the ‘stabilisation of obdurate networks of human and non-human actants is an essential feature of all technological evolution’ (Constant II 2002, p. 1254). As noted by Latour “contrary to the claims of those who want to hold either the state of technology or that of society constant, it is possible to consider a path of an innovation in which all the actors co-evolve” (Latour 1991, p. 117 italics in original). The applicability of ANT to IS studies has been the subject of increased attention over recent years (Walsham 1997, Hanseth & Aanestad & Berg 2004) and has been used to study the co-evolution of IS and organisations (Kim & Kaplan 2005). Kim and Kaplan argue that by appreciating the multiple perspectives and inscribed traits of actors as well as the role of ambiguity in creating a body of allies, ANT provides valuable insight into understanding the form of co-evolution; order emerges in the form of blackboxes after socio-technical negotiations have been articulated, contested and resolved through processes of enrolment and translation of interests.

3 CASE STUDY – THE CO-EVOLUTION OF TIMETABLING PRACTICE AT ASU

To illustrate these points we introduce our case study of the implementation of a novel academic scheduling system at a university that shall be referred to as The Australian State University (ASU). The research was conducted over a period of ten months, from an interpretive perspective, and followed project activities in real-time as a known-but-not-participating observer whilst reconstructing initiation and phase one activity from the university records. This data was supplemented by conducting 22 semi-structured interviews. To be faithful to the interpretive perspective of reporting (Walsham 1995), we note that this does not represent an objective account of ‘facts’, but rather our interpretation of events based upon the interpretation of others. All of the names used in this paper have been changed to maintain the anonymity of individuals and organisations.

ASU is a leading research-intensive learning institution ranked within the top two or three universities within Australia. The academic activities of the University are coordinated through seven Faculties which comprise 33 Schools. Class timetabling at ASU is coordinated by the Central Timetabling section and was previously performed using an application called OLDSIS that was unstable and unsupported by its vendor. Operationally, Schools would enter their scheduling requirements into OLDSIS specifying the day, time, size and room requirements. Central Timetabling would then manage the allocation of centrally-controlled rooms against the Schools’ predefined timetable. In practice the process would commence by rolling the prior year’s timetable forward so that classes
retained the same day and time, thereby taking advantage of previously-agreed timetabling compromises, and minimising changes or disruption to the routines and cycles of academic staff.

ASU Management perceived the timetable as being inflexible and inefficient, and regarded the replacement of OLDSIS as an opportunity to take control of the timetable away from the schools and academics. The University selected a US company, Stellar, even though they had no sales outside North America. Stellar offered the mature STRIPES, which provided functionality analogous to OLDSIS (i.e., optimised room allocation against a fixed day/time/staff timetable), and its planned flagship product STARS, evolving from STRIPES and nearing the end of development, which fully optimised day/time/room/staff assignments. Although Stellar tendered STARS, claiming that it would satisfy the tender without customisation, they initially delivered STRIPES to allow ASU to commence data entry whilst they finalised development of STARS.

Later, a Stellar consultant arrived onsite with a version of STARS to train the Project Team. During training he discovered that US and Australian institutions differ fundamentally in the way that they schedule courses and “needed to revise the training on the fly”. Furthermore a number of critical bugs were encountered during training resulting in Stellar producing and shipping nightly builds of the software to enable training to continue. After the consultant left, significant bugs were again encountered within the software such as: the inability to optimise; problems representing the delivery patterns of courses; and numerous bugs related to the differences between North American and Australian date representations that required several releases of the software to resolve.

The project entered a period of repeated cycles of promised delivery, missed delivery and communication vacuum followed by teleconferences with the vendor. The Project Team and Management began taking advice from ASU’s Legal Office. Due to time pressures, the lack of a working version of STARS, and the inability of the vendor to provide a definitive delivery date, the project scope was downgraded to STRIPES to produce a timetable that solely optimised room assignments whilst retaining preset days and times from prior years. Since that time, ASU have attempted in three subsequent semesters to shift to using STARS. Each has failed, forcing ASU to downgrade to STRIPES in order to produce a usable timetable.

At first glance we might say that the vendor was deceptive in the portrayal of their system and could be considered another example of the “bad cliché of software development firms that miss their deadlines”. We might also say that ASU were foolish to believe the claims of the vendor and poorly managed the contractual engagement. From a co-evolutionary perspective, however, we see a different story where the evolutionary trajectories of multiple actors collide, influencing one another in unanticipated ways.

4 INTERCONNECTIVITY, INTENTIONALITY AND CASCADING CHANGE

Timetabling at ASU was characterised by equilibrium maintained through the rhythm of the academic year (Seebeck & Kim & Kaplan 2005), and the rolling forward of locally negotiated times. Management, however, perceived the timetable embodied in OLDSIS as being inherently inflexible and inefficient compared to ones that might be attained through a system capable of optimising the days, times, rooms and staff for all classes. By actively overlooking systems functionally isomorphic to OLDSIS, Management attempted to push ASU far from equilibrium seeking not only to change the system, but to explore new control mechanisms over the academics:

“I think the main thing is to be able to take away that ‘We want to teach classes at this time on this day’. So we want to I guess, take back some control over timetabling.”

Implicated in Management’s change agenda were ASU’s academics. It has been noted that academics oppose the introduction of central timetabling systems due to a perceived lack of consistency from year to year, a perceived loss of control, and a perceived increase in management oversight in the form
of workload information (McCollum 1998, Hasan & Suratmethakul 2005). From a CAS perspective we can interpret the teaching-constraining strategies of the academics in light of their primary selection mechanisms. The emphasis upon research performance during tenure and promotion leads academics to be defensive about retaining blocks of “usable” time around their taught engagements (Kim et al. 2006). As a result the academics adopted a variety of strategies, broadly classified as selfish, reciprocal and altruistic, in the reporting of their availability in an attempt to maintain the status quo of their timetable and to subvert Management’s change efforts.

Although IS engagement is typically regarded as episodic change, the interconnectivity of systems and processes surrounding timetabling leave the overall system in a poised state. The following figure provides an overview of the interrelationship between the physical infrastructure at ASU, the various systems in which it is represented, and the administrative offices charged with operational oversight. Staff and students not only circulate within the physical infrastructure, but their interests are also represented and contested in the timetabling system which they navigate through the web-based Student System, WEBSIS, and the Campus Maps. Intentional adaptive behaviour from any of these actors results in cascading change across the system, possibly invoking a reactionary response from other actors. We demonstrate this by presenting three vignettes of cascading change.

4.1 When the lights go out

The Office of Facilities Management (OFM) is responsible for the maintenance, and oversight of centrally controlled space. In order to minimise running costs, and to protect these venues from vandalism and theft, OFM introduced a Facility Control System that provides centralised management of heating, cooling, lighting and locks. An interface was built against the previous timetabling system, OLDSIS, to automatically unlock venues and switch on the lights for scheduled classes. For Central Timetabling and OFM, this had the desirable side-effect of prohibiting ‘squattting’ – the practice of using a vacant venue without officially requesting it. Under OLDSIS, class start times and durations were represented as multiples of whole periods with classes starting and finishing on the hour. In practice, however, lecturers are expected to finish teaching at ten minutes to the hour thereby allowing students sufficient time to travel to their next class. When the new timetabling system was implemented, the prior year’s timetable was initially rolled forward into the system. Rather than
recording duration as multiples of whole periods, however, the new system allowed start and end times to be specified in HH:MM format. Central Timetabling decided that it would be beneficial for staff and students if the timetable accurately reflected the travel times, and therefore entered specific end times when preparing the subsequent year’s timetable. It was not until the timetable went live at the start of the following year that it was discovered that the Facility Control System provided no flexibility in the interpretation of class times. Lights went out at ten minutes to the hour, and doors were locked forcing the incoming class to wait until the ‘official class start’.

4.2 Contesting display authority

WebSIS is a powerful actor at ASU through the rights and resources conferred to it by the Vice-President (Admin & Finance). When PEOPLESOFT STUDENTADMINISTRATION was implemented at ASU, for example, WebSIS and its development team successfully lobbied to have PEOPLESOFT integrated behind it so that WebSIS would retain the central authority to display program, course and timetable information to the University’s staff and students. Although Stellar provide their own functionality to display timetable information on the web, there were insufficient allies to destabilise the existing order. It was therefore necessary to interface STRIPES against the existing export mechanism developed for WebSIS. Staff and students previously interpreted the delivery pattern of their classes from a single column in WebSIS labelled ‘Occurs within weeks commencing’ containing a string of Monday dates for each class. When the Project Team attempted to export data from STRIPES to WebSIS it was discovered that STRIPES exported a list of dates for when classes didn’t occur as opposed to a list of Monday dates for when classes did occur. The work request to modify the interface was designed to minimise perturbation to WebSIS so that in the end only the column headings in the WebSIS display pages were altered as demonstrated in the following figure.

Figure 3  WebSIS timetable display interface

Although the last column now displays dates for when classes don’t occur, it only does so for dates falling within each class’s start and end date range (which aren’t displayed). Therefore it’s no longer apparent whether a class commences within the first week of semester, whether it’s delayed until some later date, or whether it is a single event within a single week. Central Timetabling received numerous complaints. In some cases students arrived at their venues in the first week to find no lecturer; although the lecturer knew that the class was delayed until the second week, the students were unable to determine this from the timetable. Likewise some students missed their first lecture as their classes commenced in the week prior to the official semester start. One Senior Manager complained:

“ASU needs to weigh up the costs of all of these changes [to WebSIS] or using Web Client [Stellar’s product]. Because we’re going through WebSIS we’re tying ourselves to all these rules which are not helpful for timetabling.”

The Project Team viewed the WebSIS team negatively and actively sought to either change STARS or to undermine the authority of WebSIS through the introduction of Stellar’s Web Client. The non-delivery of STARS and the looming deadline, however, forced the Project Team to revise their strategy and attempt to modify WebSIS by using the implementation deadline to escalate their request thereby countering the WebSIS team’s ability to resist change.
4.3 Local decision making

OFM are responsible for the University’s Space Inventory System, which assigns the numbers for buildings and rooms, and the tradespeople who construct and erect the building signage. To reduce confusion for staff and students travelling between campuses, OFM directed that all buildings be prefixed with a two-digit campus code, with the exception of those on the Central campus. For the City West campus all buildings were prefixed with 62; for example 6201 for Building 1, 6202 for Building 2. Although OFM are responsible for the physical infrastructure, External Relations are responsible for the campus maps. In one incident, External Relations decided to remove all campus codes from the rooms on their maps. They reasoned that since the campus was listed on the timetable display no one was going to confuse City West 1-343 with Central Campus 1-343.

Ironically – but only for those without experience in Higher Education – the very office responsible for external communication failed to communicate their decision. Their decision was discovered by accident when the WeBSIS development team within Student Administration decided to improve their interface by including a hyperlink from the timetabled venue to the grid location on the campus maps.

“That’s when they discovered that they would click on 6201 and it wouldn’t link [to City West Building 1]. But for us to make that change [remove campus codes] is pretty dramatic and the fact remains that we did it because that’s what OFM told us to do. And we had complaints that our timetable did not match up to the official University coding.”

4.4 Blackboxes and restlessness across systems

Drawing on Luhmann’s (1993) concept of control as mediated by functional simplification which demarcates operational domains, and functional closure which creates protective cocoons that ensure the recurrent unfolding of causal relationships, Kallinikos (2005) considers that the act of closure, or blackboxing, “implies the very decoupling of the operations of the technical system from the wider organizational and social relations within which such a system is embedded” (p. 190). We would argue, however, that closure or blackboxing never decouples the system from the wider context but rather is better regarded as a temporary alignment of interests that will invariably be recontested. Although the systems and processes in our example were temporarily blackboxed, the connectivity leaves the environment in a poised state where change in one triggers restlessness across the system of systems. From this perspective we see a dual-layer model of change where continuous change unfolds within the context of episodic change of the timetabling implementation. Due to the connectivity between systems and processes, control that was once achieved through a delineation of boundaries and loose coupling has been lost. A Senior Manager summarised the problem as follows

“So we’re building systems, typically systems upon systems yet again so when you change one bit, instead of the whole system changes you’ve got to go change four other systems and one of those is the timetable system because now it doesn’t match.”

5 AN ANT PERSPECTIVE OF CHANGE

Management’s desire to produce a “fully optimised timetable” using STARS, rather than to re-establish the status quo and optimise room allocation against a fixed timetable using STRIPES, ignored the extent to which timetabling had been blackboxed by OLDSIS and the vast array of actors and assumptions that were held together contingently by it. Furthermore it ignored the possibility that the negotiations embodied within this blackbox might actually represent good trade-offs between the competing goals of room utilisation, student access and academic research time. In attempting to replace this significant actor, renegotiation would be required with all other actors. It was only after the blackbox had been opened that the Project Team discovered the extent of the task.
“We also spoke about the way that ASU has timetabled classes and the strange and peculiar practices that have now been highlighted.”

In addition to these ‘peculiar practices’ the project team also discovered significant differences between Australian and North American delivery models, as well as the inability to specify variations in teaching week patterns using STARS (Kim et al. 2005). Classes at ASU typically commence and end in the start and end weeks respectively of the semester and run for its duration, although it is becoming more common for classes to be scheduled in ‘non-standard’ patterns. For example if the semester runs for 12 weeks then some classes for the course might be delivered in a subset of these weeks such as: weeks 1-3, 6, 9; odd weeks; even weeks. The delivery patterns for some courses in the Sciences have evolved around scarce laboratory space by delivering classes in odd or even weeks. This practice enables two classes to have the same day, time, room and even instructor as they do not occur in the same weeks. The inability of STARS to model this practice prior to scheduling meant that one class would be left unscheduled. The Project Team and Stellar didn’t discover this until halfway through Phase II and it was one of the critical reasons for reducing the project scope back to STRIPES.

“That’s a bloody pain, why didn’t we think of this [during the tender evaluation]?”

It’s not that they didn’t think of this, but they couldn’t think of this; only through designing and implementing solutions did the Project Team come to understand the problem of representing course delivery patterns. Nothing within the blackbox of OLDSIS, the interface with WEBSIS nor the experiences of Central Timetabling could have prompted ASU to ask during the tender evaluation ‘How does your system schedule the times that classes do not occur?’.

5.1 Bridging inscriptions and translating interests

Not only did Management and the Project Team need to translate the interests of the schools, faculties and academics, it was also necessary to translate the interests of Stellar and non-human actors such as STARS and STRIPES. ASU is the first institution outside North America to interact with STARS and STRIPES, and numerous temporal constraints were encountered that reflect organisational and temporal inscriptions inappropriate to the Australian environment. For example, Australia uses a day/month/year format, and not the American month/day/year representation embedded in earlier versions of STRIPES and re-encountered in STARS. Such inscriptions are in principle easily solvable if the code is internationalised appropriately during development. That was not the case in STRIPES, and the path dependency of design constraints were carried forward into STARS. For a system that deals ostensibly with when things occur that’s a substantial problem: the system has to recognise that within a given year the 4th of June (04/06) is not before the 9th of February (09/02) and so not an error condition. Stellar’s developers and ASU’s project team would stumble over such misunderstandings constantly and unexpectedly. Although data packages exist that can handle these issues invisibly, Stellar did not use them; later attempts to internationalise dates merely introduced inconsistent representations that exacerbated the misunderstandings.

The time-related problems encountered by the Project Team were not limited to dates. The Project Team experienced considerable difficulties translating Stellar’s delivery models and traits to the Australian scheduling environment. During the tender process the evaluation committee, comprised primarily of administrators with a single world-view, were unable to understand or anticipate the negotiations that would be required to align these actors. Furthermore the evaluation committee could only contact North American reference sites with respect to Stellar’s products. These sites, inscribed with a single albeit different world-view, would not be able to inform the committee of potential difficulties in translating the products into an Australian environment nor would they even think to try.
5.2 The chains of translation to stabilise STRIPES

ANT tells us that order emerges in the form of blackboxes after socio-technical negotiations between actors have been articulated, contested and resolved. When this occurs, the network of aligned interests is tentatively replaced by the action itself. Despite significant effort, nearly two years has elapsed since the tender evaluation without final delivery of STARS; an outcome neither anticipated nor desired by ASU Management or Stellar. Yet we regard order as having emerged within the case.

Central Administration and the Project Team attempted to translate the interests of academics by enforcing compliance to new norms of availability without an understanding of their selection and reinforcement mechanisms. Due to the decision to downgrade to STRIPES, however, the status quo was maintained with minimal perturbation to individual academics. Had it been possible to use STARS, the potential would have existed to significantly perturb the research ability of individual academics except for those with a light teaching load. We doubt however that this would have affected the research standing of ASU since in the absence of individual adaptation or workload processes within the Schools, the existing tenure mechanisms would maintain stability by not renewing the contracts of ‘underperforming’ staff.

Although Stellar were forced to translate the interests of STRIPES when faced with immutable mobiles such as Australian date formatting conventions and the Australian academic year, it wasn’t necessary to construct long chains of translation to stabilise STRIPES. These chains were already being held in place due to the relative maturity of STRIPES with its significant body of allies, and due to the similarities in inscribed behaviour between STRIPES and OLDSIS. When the Project Team first reverted to STRIPES in September 2003, STRIPES was in its fifth major revision; the actor-network of STRIPES was stabilised by Stellar’s existing customer base of approximately 300 institutions. As with OLDSIS, STRIPES only optimises room allocations onto a fixed timetable and doesn’t require detailed knowledge of instructor availability. Therefore negotiations between STRIPES and individual academics weren’t required and the process of assigning instructors just prior to the start of semester for some classes didn’t need to change. Furthermore as the Project Team rolled the prior year’s timetable forward into STRIPES, the timetable itself acted as a stabilised actor-network containing implicit knowledge of course conflict rules and long-forgotten negotiations. Since the timetable is an obligatory passage point for academics, by stabilising the timetable STRIPES stabilised their research opportunities. Order emerged in the case but not in a way envisioned by Management. It emerged when the divergent interests of actors could be sufficiently aligned such that the network was replaced by the action itself, namely the production of a timetable. It emerged through the introduction of STRIPES and although the interests of a variety of human and non-human actors have been aligned and held stable this stability is only tentative since negotiations with STARS are still being contested.

6 DISCUSSION

We can see that this IS engagement is more than just a series of socio-technical interactions but as a system comprised of calculating actors each making moves on a co-evolving landscape. The current timetable, which evolved as a collection of compromises and accommodations over many years, creates an environment that contributes to the University achieving its vaunted superior research standing, gives academics a teaching environment which they generally consider to provide a good compromise between research and teaching time, provides reasonable utilisation of resources, and mediates the interaction of students and their lecturers. Attempting to remove by fiat the understandings that govern the timetable will only increase the mess within this ill-defined system of interrelated problems (Ackoff 1974). Due to the underlying phenomenon of co-evolution, problems can’t be solved in isolation as they change the context within which the other problems are framed.
Our understanding of the co-evolutionary dynamics of IS engagement can benefit in a number of ways from adopting teleological, dialectic and evolutionary models of change. First, a co-evolutionary perspective, particularly advocated by actor-network theory, provides the basis to consider the effect of a heterogeneous collection of human and non-human actors operating within the engagement. Not only do we consider the intentional action of Management or the administrative offices, but other external actors such as the vendor, and non-human actors such as the interrelated systems, that influence the engagement thereby expanding our purview of the context as called for by Avgerou (2001). Second, the evolutionary motor of CAS allows us to understand the driver of goal-setting and purposeful enactment, i.e. the teleological motor, of the actors within the engagement. The selection and reinforcement mechanisms, such as tenure and promotion, guide actors and their interaction strategies during the engagement. These reinforcement mechanisms represent a socially constructed feedback loop operating over a longer period of time that is itself the product of intended and unintended consequence of action. Likewise purposeful actors are continuously engaged in the reflexive interpretation of their context, interests, and past action (Weick 1979), thereby creating the shorter feedback loop of actor structuring. Third, the heterogeneous actors within the engagement are subject to either different reinforcement mechanisms that structure intentionality, or similar reinforcement mechanisms that result in competing interests, thereby explaining the driver for the dialectic motor between thesis and antithesis operating within the co-evolutionary dynamic. Although Management set the context for interaction and the agenda for IS engagement – episodic change – dialectic models such as actor-network theory allow us to understand how change plays out through the emergence of blackboxes, or as the synthesis of thesis and antithesis. Furthermore, as a result of the interconnectivity of actors and interests any stabilisation that is achieved has to be viewed as being contingent and evolving. The overriding system of systems exists in a poised state that is subject to continuous change due to the fact that the feedback loops that drive teleological motors are socially constructed and therefore subject to change thereby setting in train an unforeseen, emergent dynamic of restlessness across systems and processes.

This paper is part of a broader theoretical and empirical study into socio-technical co-evolution. From a theoretical perspective, future work is necessary to articulate a defensible synthesis between CAS and ANT, recognising that both theories have traditionally adopted different meta-theoretical underpinnings regarding ontology, epistemology, and method. Second, it remains to specify fully the interrelationships between motors in terms of the degree of nesting, the timing, and degree of complementarity (Van de Ven et al. 1995) as a basis for the conduct of further empirical research into the co-evolutionary dynamics of IS engagement.

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